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SALVADORA OLEOIDES.

[*Dictionary of Economic Products, Vol. VI., Pt. II.*, S. 705-6.]

A SHORT ACCOUNT OF SALVADORA FAT.

By DAVID HOOPER, F.C.S., F.L.S.

INTRODUCTORY.

Attention is called in the present *Agricultural Ledger* to a useful solid white fat expressed from the seeds of the Pilu or Jhal (**Salvadora oleoides**, *Dcne*), a small tree or shrub growing in Northern India. The fat is regularly employed in Cutch in the manufacture of bangalas or outer garments of Cutchee ladies, being applied as a "resist" in the process of dyeing. The oil or fat occasionally finds its way to Bombay and is probably used for other purposes. Chemical examination shows that it has a different composition to ordinary Indian fats, and its properties would recommend it for candle making and similar industrial purposes.

The information is given as a supplement to the article on the subject in the *Dictionary of Economic Products of India.*

Salvadora oleoides, *Dcne.*

Syn.—SALVADORA INDICA, *Royle.*

Vernacular names.

Vernacular.—*Pilu, jhal*, HIND.; *Jal, khokar, pinju*, PB., *Kakhan*, MAR.; *Kalawa, karkol, ughai-puttai*, TAM.; *Varagogu*, TEL. The oil: *Kinkanela*, MAR.; *Khakananutela*, GUZ.

Distribution.

Habitat.—The plant is frequent in the Panjáb, Baluchistán, Sind and Bombay. It often forms the greater part of the vegetation of the desert regions, ascending 3,000 feet in the Trans-Indus and 2,400 feet in the salt range. It is very common about Multan and Salsette.

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Both **S. oleoides** and **S. persica** grow upon the sea coast of Arabia, Persia and Western India as well as in the arid district of the interior. The differences between the two plants are as follows :—

Compared with S. persica.

S. oleoides.	S. persica.
Leaves—narrow.	Leaves—broad.
Flowers—not stalked.	Flowers—stalked.
Fruits—yellow, in bunches.	Fruits—smaller, red, not densely crowded.

Dr. J. R. Royle considered **S. persica** to be the mustard tree of the New Testament, and says that the Syrian Arabs called it *khardal, i.e.*, mustard. It is known in Persia as *darakht-i-miswak* or tooth-brush tree. It is probable that the fat is obtained from the seeds of both species of **Salvadora.**

The Fruits.

The small fruits are globose, $2\frac{1}{2}$ lines in diameter, yellow when ripe, and dark red and brownish when dry. The dried fruits resemble currants and are sweet to the taste.

Harvest of berries.

Early in June, when the fruits ripen, they are collected and eaten as food by the poor, especially in times of scarcity. They prove of considerable value to the poorer classes in Sind, Baluchistán and parts of the Panjáb. In some districts the fruit is abundant enough to attract crowds of villagers who, on payment of a nominal fee, feed themselves and their families on the berries for three or four weeks while they last. Pilu berries are thus regarded as a real staple food, and a bad pilu crop is looked upon as a calamity. In the report of the settlement of the Jhang District in the Panjáb, the Commissioner records the fact that in 1880, there was a magnificent crop of berries that ripened a month earlier than usual and was thoroughly appreciated by the poorer classes. With wheat at 10 to 12 seers (20·6 lbs. to 24·7 lbs.) per rupee (1*s.* 4*d.*) and a harvest below the average they lived for two months among the jhal trees with their flocks and consumed scarcely anything but pilu berries and milk. It was noticed by an officer at Sirsa that the people preferred to eat them by handfuls, seeds and all; but as the latter are apt to accumulate in the intestines they lead to disagreeable results. It is thus evident that in many parts of Northern India a large quantity of seeds are available which could with a little care be collected for sale and for the expression of the oil.

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The Seeds.

The seeds are roundish, about one-eighth of an inch in diameter, light brown in colour with dark brown splashes, and a prominent keel or raphe on one side. Within the shell is a pale nutty oleaginous kernel.

Analysis of seeds.

A sample of the seeds obtained from Cutch through the Director, Land Records and Agriculture, Bombay, had the following composition :—

Fat	45·48
* Albuminoids	18·94
Carbohydrates	23·48
Fibre	5·80
† Ash	3·50
Moisture	2·80
	100·00

* Containing nitrogen	3·03
† Containing sand	·30
„ phosphoric anhydride	·71

The seeds yield a fair amount of oil by warm expression. The authors of "Pharmacographia Indica" (1891), found in the seeds, in addition to the oil, a bitter, harsh tasting alkaloid, and a yellow colouring principle giving a deep, bright yellow colour with alkalis.

The Fat.

The seeds yield a fat called kakan, khakhan or kilnel oil. Dr. M. C. Cooke in "Oils and Oil-seeds in the India Museum" (1876) described it as a solid fat of a dull sulphury yellow colour. He adds that under the name of "kikuel" this oil is affirmed to be a product of the Madras Presidency. This statement, however, has not been confirmed. Dr. Dymock says, the oil of **S. oleoides** is of the consistence of butter of a bright green colour and pungent odour. That sold in the bazars, he declares to be usually adulterated, of a greenish-yellow colour and of a greater consistency or hardness than the genuine article. It is used as a stimulant in painful rheumatic affections and after child-birth.

Nature of the fat.

Use of the fat as a "resist."

The use of **Salvadora** oil in dyeing is described in the "Art of Dyeing in Western India" (1873) by Narayan Daji. The cloth or outer garment of the Cutchee ladies is called a Bangala, and is distinguished by the pattern being a red colour on a black ground. It is prepared in the following manner :—"The cloth is submitted to the safranaceous mixture and galled as for madder-red. The

Fat in dyeing.

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pattern is now stamped on it with a 'resist' composed of wax one part, and khakan (the semi-fluid oil of the seeds of **Salvadora oleoides**) two parts, melted together. The cloth is now dyed in kayo-black, and the resist removed by boiling the cloth in water. It is then passed through alum liquor, dried, and lastly steeped in a madder or morinda dye-bath, when the red pattern makes its appearance. Red pattern on a charcoal background is executed similarly to the above with the change of chemicals necessary for that tint."

Fat in dyeing.

The Dewan of Cutch, in 1902, sent to the Indian Museum, Calcutta, a series of coloured cloths prepared by the wax-resist process, and at the request of the Reporter on Economic Products supplied the following information explaining the vernacular names they bore in that district.

"The cloth used for dyeing must be white in colour for all the four varieties, *jagannathi*, *madharpat*, *malmal* and *nansukh*. They are all without exception first dipped into sesame oil and then kept in water for four days. On the fifth day they are washed with *harda* or myrobalams and alum water. The borders and ends of the cloth are then printed with a mixture of wax and oil. If *Bagidas* Nos. 1 and 2 are to be made, the cloths are dipped into a mixture of iron sulphate and kaiyo. This brings out the patterns known as *Sallo minia* and *Bagida kalo*. They differ only in lengths, the former is 11 to 12 *gajs* long, and the latter $6\frac{3}{4}$ *gajs*, (a Cutch gaj is about 16 inches in length).

"If *Rehtabhat sallo* and *Nagaria sallo* are to be made, the cloths are treated with wax printing as before and washed in kaiyo, the borders and ends of the cloth are coloured with red aniline dye locally called 'alijar,' which converts the wax printing into a red colour. At this stage the cloth is called *Rehtabhat sallo* or *Nagaria bagedo*. The difference in the two is only in the nature of the printing. If the borders and ends are coloured red the cloth is *Rehtabhat sallo*. If the printing on the borders and at the ends consists of a number of red spots or small circles with five clusters thereof in the interior the cloth is called *Nagaria sallo*. The name *Nagaria* is derived from similar cloth received in olden days from Jamnagar."

Price of oil.

The price of khakan oil in Guzerat in 1873 was three annas (3*d*.) a seer (about 2 lbs.) The Diwan of Cutch charged only R2 (2*s*. 8*d*.) for 5 lbs. of **Salvadora** seeds and 10 lbs. of the solid fat. At such a low price the fat is worthy of a larger trade.

Chemical Examination of Fat.

Khakan fat occurs in blocks of a yellowish-white colour, solid at ordinary Indian temperatures with a slightly rancid odour. A

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small quantity of the seeds extracted with ether left a light greenish fat which readily bleached on exposure to the air. The following chemical and physical constants were obtained with the commercial fat from Cutch and agreed with those obtained with the oil experimentally extracted from the seed by solvents.

Constants of the oil.

Sp. Gr. at 50°C.	·9084
Melting point	41°C.
Acid value	11·26
Saponification value	242·36
Iodine value	7·48
Reichert-Meissl value	1·28
Fatty acids per cent.	94·12
Melting point of	40°C.
Acid value of	244·42
Iodine value of	8·3

Saponification.

The fat saponifies with ease. The low iodine value and the high saponification value distinguish this fat at once from white fats found in India, such as Malabar tallow **(Vateria indica)** and Kokam butter (**Garcinia indica**). The iodine value indicates the presence of less than ten per cent. of oleic acid. The high saponification value indicates the presence of lauric or myristic acids. The fat has a higher melting point than coconut oil, palm oil and cocoa butter, and should for this reason prove of great use for the manufacture of candles and hard soaps. A pure white fat of this description would also be adapted for the preparation of ointments, suppositories and other medicinal requisites.

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DYES FROM FLOWERS.

A summary of our present knowledge regarding the use of Dyes from Flowers in India, by I. H. BURKILL, *together with two reports on* **Thespesia Lampas** *and* **Hibiscus Sabdariffa,** *by* A. G. PERKIN.

FLOWERS YIELDING DYES.

Flower colours as a rule have no connection with dyeing; and although it happens that certain are used in India by dyers, it would be the greatest of mistakes to expect flowers as a class to dye. The common yellow colouring matters of flowers—collectively called carotin—are proved to be useless industrially. The flowers which find use in India are:—

Division (i)—those in which the bright parts of the flower hold the dye—

Dhák tree or Palás (**Butea superba,** *Roxb.*, and **B. frondosa,** *Roxb.*)
Coral tree (**Erythrina indica,** *Lam.*)
Safflower or Kusum (**Carthamus tinctorius,** *Linn.*)
Marigolds or Genda (**Tagetes erecta,** *Linn.*, and **T. patula,** *Linn.*)
Harsinghár (**Nyctanthes Arbor-tristis,** *Linn.*)
Saffron (**Crocus sativus,** *Linn.*)
Balsam (**Impatiens Balsamina,** *Linn.*)

Division (ii)—those in which the dye is found as much in the other parts of the flowers as in the petals—

Asbarg (**Delphinium Zalil,** *Aitch. et Hemsl.*)
Tún or Gulnári (**Cedrela Toona,** *Roxb.*)
Rozelle or Patwa (**Hibiscus Sabdariffa,** *Linn.*)
Dhái or Dáwi (**Woodfordia floribunda,** *Salisb.*)

The following table shows where these flowers are used according to our present knowledge:—

	Himalaya.	North Western India including Sind and Punjab.	Gangetic plains.	Lower Bengal and Assam.	Burma.	Deccan with Central India, etc.	Bombay Coast.	Madras.
Delphinium Zalil.	.....	in chief centres	in chief centres	.....	.....	in Poona .	in chief centres	
Cotton .	.....	Hyderabad Jacobabad.	Mainpuri .	.....	.....	.....	.....	
Hibiscus Sabdariffa.	.....	.....	.....	.....	Shans . . .	Chutia Nagpur	.....	
Erythrina .	.....	.....	.....	Hugli, Assam .	.....	.....	.....	
Butea . .	Kashmir Almora.	General . .	General .	General but not greatly used.	General but not greatly used.	Fairly general	Apparently general at least from Bombay northwards.	
Cedrela Toona.	.....	Somewhat general.	Somewhat general.	Sparingly in Bengal.	S. Shan States	Mysore, Coorg.	Used.	
Woodfordia floribunda.	General in North-west	General . .	General . .	Somewhat general in Bengal.	General .	General . .	General . . .	Apparently general.
Tagetes .	Almora .	Lahore . .	Somewhat used generally.	.....	.....	Chutia Nagpur	Rarely if ever now.	
Carthamus .	.....	Greatly declined but used somewhat.	Greatly declined but used sparingly in most parts.	Greatly declined but used sparingly in most parts.	Used a little	Declining but fairly general.	Generally used but declining.	Used.
Nyctanthes .	Almora .	.....	Fairly general .	In several places but sparingly used.	.....	Fairly general	Fairly general	North Arcot. (Used also in Ceylon.)
Saffron . .	Kashmir .	Imported but despite statements to the contrary apparently but little used as a dye.	Imported but hardly for use as a dye.	Imported but doubtful if used as a dye except on occasion of great ceremony.	Said to be imported.	Imported but for other purposes than dyeing.	Imported but for other purposes than dyeing.	Imported but for other purposes than dyeing.

These are all the flowers actually used in dyeing in India. Of others that could be used, we know two,—both from the excellent work of Mr. A. G. Perkin. They are **Hibiscus Sabdariffa,** *Linn.*, petals—not the whole flower—and **Thespesia Lampas,** *Dalz. et Gibs.* Two preliminary reports on them which have reached me are printed below. FLOWERS USED.

It is difficult to ascertain from the literature available if and where flower-petals are used for dyeing in foreign countries as in India. Europe of course has used for long saffron and safflower, both of which came from the East: and China and Japan have had a trade with Europe in the flower-buds of **Sophora japonica** which contain a yellow dye: but beyond these three which are in no way obscure products, it is not improbable that in various countries of the world, flowers which are of no account in the European art of dyeing, have been or are used as in India. Meagreness of literature.

The chemical natures of the dyeing substances in the above-named flowers have been but in part investigated. CHEMISTRY OF THESE DYES.

Cotton has been investigated by A. G. Perkin (*Trans. Chem. Soc.*, 1899, pp. 825-829) and he names the dye present "gossypetin." Cotton.

Erythrina has not been investigated. Erythrina

Butea flowers have been investigated by Hummel, Cavallo and A. G. Perkin (*Proc. Chem. Soc.*, 1894, p. 11; xix, 1903, p. 134 and xx, 1904 p. 169): two allied bodies were found called respectively "butin" and "butein"; butin in the flower is colourless, and butein is bright orange yellow. Butea

Tagetes was investigated, first by Latour and Magnin de la Souce, and afterwards by A. G. Perkin (*Bull. Soc. Chem.*, xxviii, 1877, p. 337 and *Proc. Chem. Soc.*, xviii, 1902, p. 75). It contains a substance called "quercetagetin." Marigold.

Carthamus flowers when used in dyeing are first soaked in water that the soluble safflower yellow may be extracted; thereafter the undissolved red carthamin is withdrawn for use by means of alkali. It is a long time now since Schlieper's work on these two dyes was done (*Annales*, lviii, 1846, p. 357) and further work is called for. Safflower.

Nyctanthes flowers have recently been investigated in part (see postscript on p. 29). The dye in them is not extracted from the corolla-lobes but from the corolla-tubes. Harsinghar.

Saffron has received a good deal of attention, a result of its former wide use in Europe. The part of the flower used for dyeing is the stigma only; chopped-up petals being an adulterant which is Saffron.

CHEMISTRY. not uncommon. The colouring matter in saffron is "Crocin" (see Rochleder and Meyer, in *Journ. Prakt. Chem.*, lxxiv, p. 1, Weiss, in ditto, ci, p. 65, Kayser in *Ber. d. deutsch. Chem. Gesellsch.*, xvii, 1884, p. 2228, Schunck and Marchlewski in *Liebig's Annalen* cclxxviii, p. 349 and lastly Schueler ex *Bot. Centralblatt*, lxxxvii, 1901, p. 152).

Balsam. The colouring matter of **Impatiens** is quite uninvestigated. In a note in the *Journal of the Asiatic Society of Bengal*, 1907, p. 565, I put on record all that I then knew about its use as a dye: but since that was done I have had the good fortune to light on the following statement made by Consul-General Sir A. Hosie, (*Report on the Province of Szechuan*, 1904, p. 42): "**Impatiens Balsamina** or Chih-chia Hua—the Finger-nail flower—derives its name from the fact that a decoction of its petals is used by ladies for tinting their finger-nails "red." It is extremely interesting that the Chins on the Pi-choung in Northern Arakan should use the plant much as do the ladies of South-Western China.

Asbarg. The colouring matter of **Delphinium Zalil** has been the subject of a thorough enquiry by A. G. Perkin and J. A. Pilgrim (*Trans. Chem. Soc.*, 1898, pp. 267-275). The dyeing substances are three;—"quercetin," "isorhamnetin" and a third body, in small quantity, probably nearly allied to quercetin.

Cedrela flowers have not been investigated.

Woodfordia. In the flowers of **Woodfordia** is a great quantity of tannin associated with some colouring matter which has not been investigated.

Patwa. The rose-red colouring matter of **Hibiscus Sabdariffa** is also unstudied; but rose-red colouring matters from the petals of some of its allies have been investigated in part at least, though not enough to enable the substance to be named. The flowers of **Hibiscus Sabdariffa** are reported to contain two substances. Mr. Perkin believes one to be a new colouring body of the flavon group, while the other resembles gossypetin.

Thespesia. The flowers of **Thespesia Lampas** are reported to contain "quercetin."

CLASSIFICATION OF DYEING SUBSTANCES. I wish to show by giving a classification of these colouring matters that they are not of one group, and that we are dealing with many chemical substances partly allied and partly not; in adding after the names of the plants their natural orders, I wish further to show that these dyeing substances occur with such irregularity as at present to give us little indication where we might expect to find others.

We may class the dyeing bodies with Czapek (Biochemie der Pflanzen, Jena, ii, 1905) thus:— CHEMISTRY.

Carotin group of substances
Crocin of **Crocus sativus** (IRIDACEÆ).

Flavon group of substances
Division 1. Quercetin of **Delphinium Zalil** (RANUNCULACEÆ).
,, of **Thespesia Lampas** (MALVACEÆ).
Isorhamnetin of **Delphinium Zalil.**
Gossypetin of **Gossypium** (MALVACEÆ).
,, of **Hibiscus Sabdariffa** (MALVACEÆ).
Rutin or Sophorin of **Sophora japonica** (LEGUMINOSÆ).
Quercetagetin of **Tagetes** (COMPOSITÆ).
Division 2. Butein from **Butea frondosa** (LEGUMINOSÆ).

Not yet to be classed.
Carthamin from **Carthamus tinctorius.**

It will have been seen that most of the flower dyes belong to the group of substances which contains quercetin. Quercetin is common in the plant kingdom: it occurs in a great variety of plants and in a variety of places in them. It occurs in leaves as in the Vine, in bark as in the apple, in berries as in **Rhamnus** and in flowers as in **Cornus.** It occurs in combination in various ways in many more plants where it does not occur free: Quercitrin found in oak-bark is one combination: Rutin which comes from rue flowers and leaves, buds of **Sophora japonica** and Violet flowers is another.

Among the substances of the Flavon group are a few good dyes; and the dyeing materials containing them are in demand in Europe, *e.g.*, 'Persian Berries.'

Butein exists in flowers of **Butea** as a compound—a glucoside—decomposed by boiling and thereon yielding the true dye.

It is rather probable that chemical substances of the flavon group are products of the activity of the plant which are not further directly required for its growth, but their great variety and peculiar production suggest that they are not altogether waste, and have some relation, perhaps occasionally protective, to the economy of the particular plants which produce them. And again as this is the position of our knowledge we are prevented from anticipating the conditions of the plants wherein they might profitably be sought. This much we know that they exist in the cell sap of living cells and that from old dead wood, though they may have been present in the young living wood, they are no longer extractable.

GROWTH OF KNOWLEDGE.

Asbarg.

Delphinium Zalil as an Indian dye was first mentioned under its Sindhi name by Stocks in the *Transactions of the Medical and Physical Society of Bombay*, iii, N. S., 1855-56, p. 149. In 1868 Baden-Powell (*Punjáb Products*, p. 323), mentioned it as sold in Amritsar and Pesháwar. Stewart (*Punjáb Plants*, p. 4) in the next year mentioned it as used in Multan. He suspected that the source might be **Delphinium saniculæfolium.** Buck in 1878 (*Dyes and Tans of the North-Western Provinces*, p. 44) suggested the European **D. Ajacis** as the source of the bazaar-product. Murray (*Plants and Drugs of Sind*, 1881, p. 73) dropping Stewart's query, ascribed it boldly to **Delphinium saniculæfolium.** Liotard (*Memorandum on Dyes of Indian Growth*, 1881, p. 89) suggested, after Sir Edward Buck, that it is **D. Ajacis** which gives the dye; but he also (p. 94) names **D. speciosa** as the source of the isbarg of Siálkot and Gujránwála. Dymock (*Vegetable Materia Medica of Western India*, 1885, p. 14) followed Murray and at the same time mentioned its use in Bombay as a dye for silk.

In 1885 Aitchison as a result of his wide wanderings on the Afghan Boundary Commission, was able in conjunction with Mr. W. B. Hemsley of the Royal Botanic Gardens, Kew, to determine the true origin as a new **Delphinium—D. Zalil**—which "forms a great proportion of the herbage of the rolling downs of the Badghis" in Western Afghánistán. In 1889 this name was taken up in Dymock, Warden and Hooper's *Pharmacographia indica*, p. 23, and in 1890 in Sir George Watt's *Dictionary of the Economic Products of India.* Since then, with two exceptions, writers have been clear regarding the origin of the dye.

Fawcett in his *Monograph on Dyes and Dyeing in the Bombay Presidency*, 1896, p. 17, mentions its use in the jails of that Presidency, *e.g.*, Shikárpur, and in the towns of Poona, Surat, etc. Munshi Saiyid M. Hadi mentions its use (but without saying where) in the United Provinces (*Monograph on Dyes and Dyeing in the North-Western Provinces*, 1896, p. 82). Sir Thomas Wardle in 1886 did some dyeing experiments (*Report on Dye-stuffs of India*), obtaining by various processes on silk and wool delicate yellows, a dull yellow and a greenish yellow. To his results we shall shortly return.

Cotton.

Cotton flowers are first mentioned as a dye by Liotard in his *Memorandum on Dyes of Indian Growth*, 1881, Appendix, p. iii., as being used in the Mainpuri district. Sir Thomas Wardle when specimens were required for his investigations got them from Jacobábád and Hyderábád in Sind. From these places alone is such a use reported. Perkin accidentally substituted Manipur for Mainpuri in the *Transactions of the Chemical Society*, 1899, p. 825,

and the same substitution was copied into the *Technical Reports and Scientific Papers of the Imperial Institute*, 1903, pp. 216 and 222.* GROWTH OF KNOWLEDGE.

Hibiscus Sabdariffa has fleshy red calyces and pale yellow flowers. The yellow flowers are just capable of dyeing yellow, but are not used at all in India: the red calyces are used in a very obscure degree in two remote parts of the country, and the observation of it long escaped detection. Their use in Chutiá Nágpur was made known by the Rev. A. Campbell in his *Descriptive Catalogue of the Economic Products of Chutiá Nágpur sent to the Colonial and Indian Exhibition*, 1886, p. 10—a mere mention; and their use among the Shans was made known by Leveson in *A Note on Dyes and Dyeing in the Southern Shan States*, 1896, p. 8. Patwa—Hibiscus Sabdariffa.

Sir William Jones, first in European literature (*Asiatic Researches*, iv, 1798, p. 289), made mention of the yellow dye of the flowers of **Cedrela Toona,** and not for many years do we find it mentioned again. The next two occasions on which mention was made, were when Lindley and Moore in their *Treasury of Botany*, i, 1866, p. 243, wrote that a red dye is yielded by the flowers, and two years later when Baden Powell (*Punjáb Products*, i, 1868, p. 448) wrote of a yellow dye yielded by the flowers, and obtained by him from the bazaars of Ambálá, Kángrá, Amritsar, Lahore and Patiála. Stewart (*Punjáb Plants*, 1869, p. 34), Sir Dietrich Brandis (*Forest Flora, North-West and Central India*, 1874, p. 73) and others thereafter mentioned it. In the *Report of the Land Revenue Settlement, Hazára*, 1876, p. 11, its use in that district is given. In 1877 in the *Gazetteer of Mysore and Coorg*, i, p. 51, its use there is given. Sir Edward Buck (*Dyes and Tans of the North-Western Provinces*, 1878, p. 28) gives the method of dyeing with it in Cawnpur and Farukhábád. Liotard (*Memorandum on Dyes of Indian Growth*, 1881, p. 82) adds a little information to this. M'Cann (*Dyes and Tans of Bengal*, 1883, p. 73) names Lohárdagá, Patná, Sáran, Darbhangáh and Monghyr as places where the dye is used, but sparingly: "it is scarcely a marketable commodity," he says. In the *Bombay Gazetteer*, xv, 1883, p. 66, the use of the dye in Kánara is superficially mentioned, and in vol. xxv, 1886, p. 241, a general statement is made that it is used in the Bombay Presidency. Sir George Watt in his *Guide to the Economic and Commercial Court*, 1886, p. 283, adds a statement that it is used in Burma. Saiyid Mohammed Hadi in his *Monograph on Dyes and Dyeing in the North-Western Provinces*, Cedrela Toona.

* The cotton flowers examined by Mr. A. G. Perkin came from Cawnpur. They were collected specially, and were not a bazaar sample.

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1896, p. 79, states how it is sometimes used in conjunction with turmeric, and Nagendra Náth Banerjee, *Monograph on Dyes and Dyeing in Bengal*, 1896, p. 26, describes a method of dyeing in Muzaffarpur and remarks how rarely it is used. Duncan in his *Monograph on Dyes and Dyeing in Assam*, 1896, p. 18, expressly says that it is not used in that province.

Sir Thomas Wardle experimented with it.

Dhak or Butea.

Sir William Jones, and Buchanan-Hamilton well knew the use of the flowers of **Butea frondosa** (*see Asiatic Researches*, iv, 1798, p. 308, and *Statistical Account of Dinájpur*, written in 1807 and reproduced in Montgomery Martin's *Eastern India*, i, 1838, p. 237; Roxburgh also knew how the flowers dye (*Flora indica*, ii, 194). Again in 1826, Ainslie (*Materia Medica*, ii, p. 335) wrote of the use of the dye. In 1841 Irvine (*General and Medical Topography of Ajmir*, p. 203) mentions dyeing as practised with them in Ajmir. Voigt, who wrote from Serámpur, in 1845 (*Hortus suburbanus*, p. 238) mentions the dye as done on cotton previously prepared with alum when it gives a yellow colour, which may be changed by alkali into a deep reddish orange. Walter Elliot in his *Flora Andhrica*, p. 183, mentions the dye as used by the Telegus. Baden Powell (*Punjáb Products*, 1868, p. 370) made known its use in the Punjáb. Stewart following him (*Punjáb Plants*, 1869, p. 60) says 'the flowers are used in dyeing basanti, a fleeting yellow, in preparing the Holi powder.'

An extract from the Records of the Government of India published in the *Journal of the Agricultural and Horticultural Society of India*, ix, 1857, Selections, p. 54, states that the dye was well known in Burma.

I shall now take the references province by province, beginning with the North-West of India.

In regard to Kashmir, Baden Powell (*Punjáb Products*, 1868, p. 448) records its use: and Atkinson records its use in the Himálayan districts of the North-Western Provinces (*Gazetteer*, 1882, x, p. 798).

Its use in the Punjáb plains is universal. It is recorded by Baden Powell (*Punjáb Products*, 1868, p. 448) that it was in his time known to him to be used in the districts of Rohtak, Gujrát, Ambálá, Jhelum, Jálandhar, Sháhpur, Kángra, Gugera, Gujránwála, Dera Ghází Khán and in Kapúrthala State. Its use is recorded for the Montgomery district in the *Report on the Settlement*, 1878, p. 18, and in the *Gazetteer*, 1884, p. 18.

Sir Denzil Ibbetson (*Settlement Report*, 1883, p. 10) recorded its use in Karnál. Its use in Amritsar was recorded in the *Gazetteer*,

2nd edition, 1893, p. 8, and in Múltán in the *Gazetteer*, 1884, p. 10). GROWTH OF KNOWLEDGE.

Liotard, *Memorandum on Dyes of Indian Growth*, 1881, p. 79, recorded its use in the districts of Ludhiána, Hoshiárpur, Amritsar, Gurdáspur, Lahore, Gujránwála, Jhelum, Gujrát, Sháhpur, Jhang, and Montgomery as well as some of those named above.

In the United Provinces according to Sir Edward Buck (*Dyes and Tans of the North-Western Provinces*, 1878) its use is also general; and it is further mentioned as used in the Bijnaur district in the *Settlement Report*, 1874, for that district, p. 12.

Its use in Bombay is recorded as occurring in the following:—Thána district (*Gazetteer*, xiii, p. 26), Kánara district (ditto, xv, p. 64), Poona district (ditto, xviii, p. 50), Baroda State (ditto, vii, 1883, p. 41) and Gujrát (ditto, xxv, 1886, p. 243). It is recorded also for the Savant Vádi State (*Catalogue of the Westropp Museum*, 1888, p. 88).

That it is used in the Nizám's Dominions, is stated by Liotard (*Memorandum on Dyes of Indian Growth*, 1881, p. 80) and by Biscoe (*List of Hyderábád Trees*, 1895, p. 4).

Regarding Madras it appears to be used in the Trichinopoly district (Moore, *Manual of the Trichinopoly district*, 1878, p. 76) but the author is not very explicit. It is recorded as used in the North Arcot district (Cox, *Manual of the North Arcot district*, revised by H. A. Stuart, i, 1895, p. 27). Liotard records that it is used in Mysore (*Memorandum on Dyes of Indian Growth*, 1881, p. 80).

In the Central Provinces its use is confirmed in the Chándá district by the *Report on the Land Revenue Settlement*, 1869, p. vi, Appendix, and the similar *Report on the Settlement of the Upper Godavery district*, 1869, p. 38, and in the Mandlá district (*Report on the Land Settlement of the Mundlah district*, 1870, p. 88), and also in the Damoh district (Russell, in *Central Provinces District Gazetteers*, 1906, p. 8). I can add that it is used in Berár, in the Amráoti district, on the authority of information in my office.

Its use in Bengal is recorded thus:—Palámau, Bhagalpur, Patná, Monghyr, Mánbhúm, Cuttack, Lohárdagá, Sáran, and Puri (M'Cann, *Dyes and Tans of Bengal*, 1883, p. 73), Dárjíling Terai (Gamble, *List of Trees and Shrubs of the Darjeeling District*, 1878, p. 27), Chutiá Nágpur (Campbell, *Descriptive Catalogue of the Economic Products sent to the Colonial and Indian Exhibition*, 1886, p. 5), and Cuttack district (Nagendra Náth

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Banerjee, *Report on the Agriculture of the District of Cuttack*, 1893, p. 200).

In Eastern Bengal it is known to be used in Dinájpur and Chittagong (M'Cann, *Dyes and Tans of Bengal*, 1883, p. 74). Darrah in his *Notes on Cotton in Assam*, 1885, p. 35, mentions its use without saying where.

It is recorded as used in the Minbu district of Burma by Captain A. T. Gage, in the *Records of the Botanic Survey of India*, 1904, p. 135.

Sir Thomas Wardle did many experiments with **Butea** flowers and Professor E. Watson has done others. Sir Thomas Wardle (*Report on the Dyes and Tans of India*, 1887, pp. 7, 20, 36-38 and 51) tried the dye of flowers from Hyderábád, Sind, and the Central Provinces on silk, cotton and wool and got various shades of yellow and bright orange. He remarks that they are rich in colouring matter and will produce bright and strong shades. Further information about these experiments will follow later.

Coral tree—Erythrina indica.

Erythrina indica is a sea-coast tree, which occurs wild in but a few places inland; however it is readily cultivated in many places. Its flowers are very little used. M'Cann (*Dyes and Tans of Bengal*, 1883, p. 66), says briefly "this tree is mentioned in the report from Húghlí as producing a red dye. The flowers are collected about the end of February, and when dried and boiled in water yielded a red dye."

It is again mentioned by Darrah (*Note on Cotton in Assam*, 1885, p. 33) as yielding (he does not say where) a red dye.

No one else mentions such a use.

Dhai—Woodfordia floribunda.

Woodfordia floribunda grows everywhere in India except on the plains of Lower Bengal: it generally flowers profusely, and consequently, the dye is usually procurable with little trouble. Roxburgh mentions the use of the flowers as dye, and so does Buchanan-Hamilton who saw them sold in 1813 at Lálganj in the district of Gorakhpur (Montgomery Martin, *Eastern India*, ii, 1838, p. 521). Irvine mentions their use as a dye in his book entitled "*Some Account of the General and Medical Topography of Ajmeer*," 1841, p. 133. Honigberger, in 1852 (*Thirty-five Years in the East*, ii, p. 282) recorded its use in Lahore as a dye. In 1865 J. L. Stewart wrote (*Journal Agri. Hort. Soc.*, xiii, p. 307) of the collection under the Siwaliks near Bijnaur and export thence for dyeing. In 1859 Stewart again mentions its use in a "Journal of a Tour in Hazára and Khághán" (*Journal Agri. Hort. Soc. India*, xiv, p. 15). Birdwood mentioned it in his *Catalogue of Vegetable Products of*

the Presidency of Bombay, 1865, p. 298. In 1873 Drury (*Useful Plants of India*, p. 236) called attention to a considerable trade of it from the hills of Khándesh. Its use is mentioned in the Records of the Government of India, quoted in the *Journal of the Agricultural and Horticultural Society*, ix, 1857, p. 54. After these dates many writers mention it.

Upon its use on the North-Western Frontier, Stewart's statement regarding Hazára has been quoted. Sir Dietrich Brandis mentions it in his *Forest Flora of the North-West and Central India*, 1874, p. 238, as collected beyond the Indus for use in the Punjáb. In the Punjáb its use in the Sutlej valley is mentioned in the *Journal of the Agricultural and Horticultural Society of India*, xii, 1865, p. 391, and in the Salt range (*ibid*, New Series, 1869, p. 89). Its use is again mentioned in the *Gazetteer of the Ráwal Pindi district*, 1884, p. 15.

Its use in Rájputána, we know from Irvine as quoted, and again from Sir George King in the *Indian Forester*, iv, 1879, p. 228. I have received flowers from the Political Agent, Bhopáwar, who records in a letter their use as a dye.

In the United Provinces, Sir Edward Buck names it (*Dyes and Tans of the North-Western Provinces*, 1875, p. 37), and gives the quantity brought to the plains from Bijnaur, Rehar, Garhwál and Kumáon in the years 1874-75 and 1875-76. Atkinson (*Gazetteer, Himálayan Districts*, 1882, p. 778) again mentions the considerable export. Saiyid Mohammed Hadi in his *Monograph on Dyes and Dyeing, North-Western Provinces and Oudh*, 1896, p. 81, mentions the dye in passing.

In Bengal the extent of its use is set forth by M'Cann (*Dyes and Tans of Bengal*, 1883, p. 153). Nagendra Náth Banerjee (*Report on the Agriculture of the District of Cuttack*, 1893, p. 49) says that it is hardly used as a dye in Cuttack; however in his *Monograph on Dyes and Dyeing in Bengal*, 1896, p. 33, he gives an account of the way in which it is used in Serámpur. Claude J. Dumaine (List of Timber Trees and useful Plants of the Hazáribágh Zillah Forests in *Journal Agri. Hort. Soc.*, ii, 1870, p. 229) names it as a Chutiá Nágpur dye. Rev. A. Campbell gives explicit information when he writes (*Descriptive Catalogue of the Economic Products of Chutiá Nágpur sent to the Colonial Exhibition in London*, 1886, p. 3) the flowers are exported in large quantities to Patná and Cawnpur.

Regarding the Central Provinces, its use in Hoshangábád was mentioned in the *Settlement Report* of 1865, p. 180, and its use in the Ráipur district (*Settlement Report*, 1869, p. 76). Russell in his

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Monograph on the Dyeing Industry of the Central Provinces, 1896, pp. 6-7, gives an account of its use.

In Bombay, it is collected in Khándesh, and in the Panch Maháls (*Gazetteer*, iii, 1879, p. 203) Fawcett, *Monograph on Dyes and Dyeing, Bombay*, 1896, p. 15, describes its use. Talbot (*List of Trees, Shrubs, etc.*, 1902, p. 174) mentions the dye.

Upon its use in the Nizám's Dominions, we have as authority Biscoe alone (*List of Hyderábád Trees*, 1895, p. 15).

Its use in Madras is mentioned in the *Manual of the Madras Administration*, i, 1885, p. 313.

In Burma its use was made known in 1857 as quoted. Kurz mentions it again (*Forest Flora of British Burma*, i, 1877, p. 518), but in the *British Burma Gazetteer*, i, 1880, p. 128, is a statement to the effect that the dye was little known. Does this mean in Pegu or to Europeans?

Sir Thomas Wardle experimented with it.

Safflower—Carthamus tinctorius.

It is not necessary to say very much about Safflower here, as a great deal of information is readily available in the *Agricultural Ledger* No. 11 of 1904, entitled "*Carthamus tinctorius*—Safflower, a digest of correspondence conducted by the Office of the Reporter on Economic Products," by R. Abbey-Yates. The use of the dye has greatly decreased during the past quarter of a century; its export from India is greatly reduced. The dye is in demand for religious observances and ceremonies; auspicious marrying seasons still cause some fluctuation in local prices. Everywhere throughout India the use of the dye is known.

Baden Powell in his *Punjáb Products*, 1868, pp. 447-448, names the dye as having been sent to him from most of the districts of the Punjáb and he gives the shades produced by it. Pandit Bhág Rám in his *Report on Dye-stuffs of Indian Production* details its use in Ajmir. Sir Edward Buck gives full information on its use in the United Provinces (*Dyes and Tans of the North-Western Provinces*, 1878, pp. 11-15), and further information can be gathered from Saiyid M. Hadi's *Monograph on Dyes and Dyeing in the North-Western Provinces and Oudh*, 1896, pp. 76-77.

For the Bengals, reference may be made to M'Cann's *Dyes and Tans of Bengal*, 1883, pp. 4-17, and to Nagendra Náth Banerjee's *Monograph on Dyes and Dyeing in Bengal*, 1896, pp. 16, 22, and 38.

Regarding its use in Assam reference may be made to Duncan's *Monograph on Dyes and Dyeing*, 1896, pp. 17-18.

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For the Central Provinces, reference may be made to Russell's *Monograph on the Dyeing Industry of the Central Provinces*, 1896, p. 13 and for Berar to B. B. Sule, *Monograph on Dyes and Dyeing in the Hyderábád Assigned Districts*, 1896, pp. 2-3.

Regarding Bombay, Liotard (*Memorandum on Dyes of Indian Growth and Production*, 1881, pp. 21-32) gives some information, and a most interesting account is to be found in the *Bombay Gazetteer*, xvi, 1883, pp. 172-175, of dyeing with it at Násik. In Fawcett's *Monograph on Dyes and Dyeing in the Bombay Presidency* is full information.

Liotard (*loc. cit.*) gives some information regarding Madras and a little more is to be found in Holder's *Monograph on Dyes and Dyeing in the Madras Presidency*, 1896, p. 3.

Liotard (*loc. cit.*) also offers a very little information regarding Burma. Theobald in Mason's *Burma, its People and Products*, ii, 1883, p. 396, offers a little more, explaining how general is its use.

Sir Thomas Wardle made experiment with this dye. Watson has also examined the dye.

Marigolds—Tagetes spp.

The two plants **Tagetes erecta** and **patula** are natives of America, whence they were introduced into European gardens and then from Europe into India. The ease with which they can be grown and the favour of their colour for sacred uses, must soon have made them to be spread widely in India; and probably in Upper India it was discovered that the flowers would dye. Those who used **Butea** must have discovered the dye of **Tagetes.**

In modern literature Atkinson (*Gazetteer of the North-Western Provinces, Himálayan Districts*, p. 778) first records that, "the flowers yield a yellow dye which is but little used except by the poor." Baden Powell (*Punjáb Products*, 1868, p. 358) mentions their use in the Punjáb: Buck and Liotard mention their use in the United Provinces in detail (*Dyes and Tans of the North-Western Provinces*, 1878, p. 29, and *Memorandum on Dyes of Indian Growth*, 1881, p. ii, Appendix.) "The dye is extracted from the flowers in the same manner as from the dhák (**Butea frondosa**): they are soaked in water, and squeezed by hand. The dye is but little used by dyers, though the common people not unfrequently dye their own clothes with it. The shade of yellow known as 'gendia' is produced by it, and it is occasionally used in place of harsinghur or turmeric in producing the colour 'champai.'"

M'Cann (*Dyes and Tans of Bengal*, p. 140) found that **Tagetes patula** flowers were used in Lohárdagá to give with an alum mordant a dull green colour.

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There are no explicit records of its use in other parts of India. Several writers happen to mention its use but merely in quotations from those named above, Duncan alone (*Monograph on Dyes and Dyeing in Assam*, 1896, p. 51) certifies that to his knowledge it had no use as a dye in Assam.

Sir Thomas Wardle experimented with it on silk and wool, and says that he found the flower to contain a moderate amount of colouring matter and to produce by different processes used various colours all containing more or less of a yellow element. His specimens are preserved in the Indian Museum and we shall return to them later.

Harsinghar—Nyctanthes Arbor-tristis.

Nyctanthes Arbor-tristis is a native of India, and is very abundant wild in the Terai and forests on the lower slopes of the Himálaya. Southwards it becomes less common wild than cultivated; consequently the supply of its flowers for dyeing diminishes southwards. Unless it be that writers on southern products have overlooked the use of the plant, the following references distinctly indicate that as a dye the Tamils, and their neighbours do not use it as do the dwellers in Northern India. Cooke in his *Flora of Bombay*, ii, 1904, p. 116, doubts if it be wild in that Presidency: however several writers on the forests of the Central Provinces speak of it as a useful forest product.

Linschoten who travelled about Gujrát in the sixteenth century found out that the flowers are used as a dye. He says (*Voyage of John Huyghen van Linschoten to the East Indies*, edited by Burnell, Tiek and Yule, 1885, p. 58) "the flowers . . . in India they use for saffron, therewith to dresse their meats and to die with all as [we doe] with our Saffron."

Nyctanthes Arbor-tristis yields the yellow dye from more than its corolla-tubes:—thus Buchanan-Hamilton found the bark to be used by garland-makers at Dinájpur, Eastern Bengal, in 1807, to give a yellow colour to sola pith where Safflower or Kusum is now generally used in Bengal at least (Montgomery Martin, *Eastern India*, 1838, ii, p. 933). Irvine (*Materia Medica of Patná*, 1848, p. 48) mentions the use of the flowers as a dye. Its use as a dye plant is again mentioned by the author of *Report on the Land Revenue Settlement of the Hoshangabad District*, 1865, p. 180, but the part of the plant used is not named. Sir Edward Buck is the next explicit writer: in his *Dyes and Tans of the North Western Provinces*, 1875, p. 25, he describes how the fallen flowers are collected in the morning from the ground under the bushes, dried, boiled in water when the dye is wanted and the cloth stained in the infusion becoming buff or orange.

Balfour (*Cyclopædia of India*, third ed., 1885, ii, p. 1116) speaking of the plant's occurrence under the Vindhyas, says the bark is used for tanning, the flowers for dyeing silk yellow. It is used in Surat.

Thwaites (*Enumeratio Plantarum Zeylaniæ*, 1864) says priests' robes are dyed with **Nyctanthes** in Ceylon.

The flowers teste Liotard (*Memorandum on Dyes of Indian Growth*, 1881, p. 59) were sold in the largest bazaars of the United Provinces at prices ranging from Rs. 10 to Rs. 60 (13*s*. 4*d*. to 80*s*.) per maund (82 $\frac{2}{7}$ lb.), and he quotes Baden Powell as authority for its sale in Delhi, Gurgáon, Ambálá and other places in the Punjáb. The writer of the *Gazetteer of the North-Western Provinces and Oudh*, x, Himálaya districts, said that it was much used, and the price of its flowers 2—6 seers (4·12 to 12·36 lb.) per rupee (1*s*. 4*d*.) *i.e.*, *about* Rs. 6$\frac{1}{2}$—Rs. 20 (8*s*. 8*d*.—26*s*. 8*d*.) per maund (82$\frac{2}{7}$ lb.).

M'Cann (*Dyes and Tans of Bengal*, 1883, p. 42) records its general sale in Bengal at prices ranging from 3 annas to 28 annas (3*d*. to 2*s*. 4*d*.) per seer (2·06 lb.), *i.e.*, Rs. 7$\frac{1}{2}$ to Rs. 70 (10*s*. to 93*s*. 4*d*.) per maund (82$\frac{2}{7}$ lb.).

While Sir Edward Buck says that the preparation of the dye is made by boiling 10 gallons of water containing 12 seers (24·72 lb.) of flowers down to 1 gallon, M'Cann says that in Bengal the boiling down is not carried so far, 9 gallons being boiled down to 3 or 6. M'Cann adds that the proportion of flower-tubes to water varies enormously from 1 seer to 1$\frac{1}{2}$ ($\frac{9}{160}$ths to $\frac{3}{160}$ths gal.) of water (Dinájpur) to 1 seer to 40 seers ($\frac{2}{160}$ths to 8 gal.) of water (Húghlí) and he adds that there is probably no fixed rule.

The writer of the Kánara volume of the *Bombay Gazetteer*, xv, 1883, p. 437) says that the flowers are used for dyeing. Nagendra Náth Banerjée (*Report on the Agriculture of the District of Cuttack*, 1893, p. 199) writes briefly of the drying of the corolla-tubes for dyeing and so also does A. F. Cox, (*Manual of North Arcot District*, revised by H. A. Stuart, i, 1895, p. 31).

Duncan (*Monograph on Dyes and Dyeing in Assam*, 1896, p. 37) states that the dye is used in Sylhet and Darrang: what he says is worth quoting in full. In Sylhet the process of dyeing with the plants is as follows: "Take half a seer (1·03 lb.) of the corolla-tubes of the flowers and boil them in 5 seers (1 gal.) of water till the volume is reduced to about 4 seers ($\frac{4}{5}$ths gal.)." Note this is less than other boilings given above. "Then put in 1 chittak (2·057 oz.) of nitric acid. The result is a permanent orange colour. If only half a chittak of nitric acid be used, the result is a much lighter

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orange. If the orange thus obtained is really a fast colour, the above process is interesting, because hitherto no means of rendering the colour fast has been discovered or rather published. The plant is known in the Assam valley, but its use appears to be confined to the Darrang district, and even there it is reported to be becoming rare. It is used in Darrang occasionally to dye silk thread. The corolla-tubes are kept in water—it is not stated whether the water is hot or cold—for six hours when the water becomes quite yellow. The thread is then put into the water, and kept there six hours, and is then taken out and dried; when dry it is a deep yellow. This account is remarkable inasmuch as boiling does not enter into the process at all: no mordant is used, and I presume the colour obtained is not a fast one."

Next Russell (*Monograph on Dyeing Industry of the Central Provinces* for 1896, p. 15) mentions the dyeing as practised there.

Mention has been made of the statement by Buchanan-Hamilton that the inner bark was in his time used to give a yellow dye. Dymock (*Vegetable Materia Medica of Western India*, 2nd edition, 1885, p. 474) says that the leaves stain the saliva yellow if chewed. It has not been shown if it is the same dyeing substance which is in the bark, leaves, and flowers; but it is probable that it is the same substance.

Sir Thomas Wardle examined the dyeing properties of the flowers and reported on them.

Saffron – Crocus sativus.

Saffron is too expensive to be used as an ordinary dye. The fairly large quantities which India consumes are used up in religious observances, in medicine and for colouring food: rarely, and only on great occasions, as for instance in marriages among the richest, are clothes dyed with it—and in that the use is again religious. The use in Bengal is recorded by Nagendra Náth Banerjee (*Monograph on Dyes and Dyeing in Bengal*, 1896, p. 30); but of its use as a dye for clothes, no explicit mention is made by those who have written upon dyeing in other provinces except that Liotard (*Memorandum on Dyes of Indian Growth*, 1881, p. 94) describes the process of dyeing. It is used in Kashmir and Upper India for caste marks.

INCOMPLETENESS OF PRESENT INFORMATION.

In the preceding paragraphs (pp. 7—23) I have given, in outline, what we know at present regarding the uses in India of these flower-dyes. If we are to know more, the information should be collected at once, lest their uses go out before we seek it. The flower-dyes are apparently far more used in Upper India than in Southern India, but in regard to Madras our information is more meagre than in regard to the Punjab and the United Provinces.

FLOWER DYES MORE USED IN THE NORTH THAN IN THE SOUTH.

This has been due to the many excellent men who have devoted their time to investigations on industries in Northern India—men like Baden Powell of the Civil Service, Lindsay Stewart, a Forest Officer, Aitchison of the Indian Medical Service, and others still alive; whereas Southern India has had few men who have found such interests.

According to our present information cotton flowers are only used as a dye in the Punjáb, Mainpuri, near the Punjáb border, and Sind.

Marigold flowers are only used along the borders of the Ganges valley from the Punjáb to Lohárdagá in Bengal.

The use of **Delphinium Zalil** is wider: it extends through the Punjáb and Sind into the United Provinces and some unknown distance down the Presidency of Bombay. The use of **Cedrela Toona** flowers is a little wider still: they are employed in the Punjáb, the United Provinces, parts of Bengal and in parts of the Bombay Presidency, appearing southwards in Kánara and also in adjacent Mysore and Coorg.

Woodfordia flowers are used over Northern India and as far South as the Nizám's dominions: possibly they are also used in some parts of Madras and perhaps also in Burma.

Nyctanthes flowers are known to have been fairly generally used in Northern India, though apparently not in the Brahmaputra valley. Southwards their use extends at any rate interruptedly to Ceylon.

To **Butea** and **Carthamus** may be ascribed a general use over all India.

Quite local and peculiar is the use of **Impatiens Balsamina** among the Chins and possibly some tribes of Assam, of **Hibiscus Sabdariffa** among the Shans and people of Chutiá Nágpur, and of **Erythrina** at Húghli in Bengal.

ANILINE COMPETITION.

Aniline dyes, which are now imported into India in considerable quantities with a view to displace the indigenous dyes, may be sold under the names that belong in one or other of the vernaculars to the natural dye. Thus for instance we find among these Aniline dyes boxes labelled 'Kesari pucca', *i.e.*, genuine saffron. However as regards the flower-dyes this is the only instance that I can quote.

COLOURS GIVEN BY FLOWERS THAT DYE

I now propose to pass on to a consideration of the colours that these flower-dyes give. They are all yellow, orange, yellowish, brown, drab or rose-red: but some of the yellows are very beautiful colours. The following table is compiled from Sir Thomas Wardle's report:—

	Silk.	Bleached tusser.	Unbleached tusser.	Wool.	Bleached cotton.	Unbleached cotton.
Delphinium Zalil. Asbarg.	bright and also light yellow.	yellow. brownish yellow.	dull yellow. brownish yellow.	greenish yellow.	.....	.....
Cotton flowers . (**Gossypium**).	bright yellow. greenish yellow. bright brownish yellow. reddish yellow.	brownish yellow. reddish yellow. drab.	brownish yellow. fawn. reddish yellow. drab.	bright orange. reddish yellow.	faint yellow.	light yellow.
Thespesia . .	light reddish yellow. light brownish yellow. light greenish yellow.	light yellow. light reddish yellow. dull greenish yellow. light grey.	light brown yellow. light yellowish drab.	reddish yellow. yellowish grey.	.....	.....
Tún flowers . . **Cedrela Toona**	bright yellow. brownish green.	brownish yellow.	brownish yellow.	light yellow. brownish yellow. greenish yellow.	yellow.	yellow.
Dhák flowers . . **Butea frondosa**	light yellow. bright yellow. fawn. brownish yellow. yellowish grey. grey-drab.	yellow. brownish yellow. yellow grey. drab.	yellow. brownish yellow. brown orange. fawn. yellow drab. drab.	bright yellow. bright orange. brown orange. greyish yellow. drab.	brownish yellow. greyish yellow. reddish drab. fawn. drab.	.....
Carthamus . Safflower yellow.	brown-yellow.	brown yellow.	brown yellow.	.....	yellowish grey.	light brown yellow.
Carthamus . Safflower-red.	deep red. deep crimson.	deep red. yellowish red.	deep red. brown red.	yellowish red. scarlet.	bright pink. bluish pink.	bluish pink.
Marigold flowers . **Tagetes.**	yellowish grey.	light brownish yellow.	brownish yellow. drab.	deep brownish yellow.	.....	.....
Woodfordia .	light reddish grey. brownish grey. brownish yellow. greenish drab.	yellowish grey. yellowish brown. light brownish yellow. greenish drab.	brownish yellow. yellowish brown. brown. brownish grey. reddish slate. deep slate.	brownish yellow. brownish grey.	light slate.	slightly grey.
Harsinghár . . **Nyctanthes.**	light yellow. bright yellow.	bright yellow.	light yellow. bright yellow.	bright yellow. dull yellow.	.....	.....

PERMANENCE. Fading of dye.

After writing his report Sir Thomas Wardle sent out to India in 1886 the samples of cotton, silk and wool that he had dyed with the various Indian dyes; and they were deposited in the Bengal Economic Museum. These examples are now in the Indian Museum, and I have examined them all, comparing the present colours with Sir Thomas Wardle's descriptions. Most of the specimens have not been exposed to light but have been kept in large folios just as received; though others, since 1899 or 1900, have been exhibited in the diffused but good light of the Economic Gallery of the Indian Museum. I shall now make some remarks upon these specimens. Out of the long series which has not been exposed to light, tissues of corah silk, tusser, wool and cotton, dyed with **Nyctanthes** and Tún flowers have faded much, often completely so. So much more have they faded than the others that we must set them down as distinctly inferior. Cotton flower-dye has also faded or changed on all these tissues. I do not understand the changes. One sample of which is described as being orange in 1886 is now ochre—a darkening,—one sample of wool described as being reddish-yellow in 1886 is greenish-yellow now, and a sample of corah silk which was reddish-yellow in 1886 is pale-yellow now.

Changes in other dyes are not generally detectable, but some deadening of the brilliance is to be expected in almost all. However a sample of corah silk dyed with **Delphinium Zalil** by one of Sir Thomas Wardle's processes is still of brightness hardly to be excelled.

The samples which have been exposed to light are from three dyes only: **Butea,** Safflower and **Woodfordia.**

Butea shows more signs of fading on cotton than on other tissues: it shows some sign of fading on corah silk and tusser but not much: on wool in a pale shade it shows the same sign of fading, but not in a rich orange.

The duller colours of **Woodfordia** are perhaps a little faster to light: very few of the specimens in the Indian Museum show distinctly that they have faded.

The colours of safflower have all faded more or less, whether of safflower yellow or of safflower pink: safflower yellow on cotton has faded completely, and almost completely on silk. This dye is of course known to be fugitive. Safflower red has nowhere faded completely, but has faded very greatly on every fabric whether silk, cotton or tusser. There are no samples of it on wool.

This is all that I have to say about Sir Thomas Wardle's specimens. I have next to mention the colours which Hummel and Perkin obtained.

PERMANENCE.

Hummel and Perkin (*Journ. Soc. Chem. Industry*, xiv, 1895, p. 459) tried the flowers of **Butea** and after showing that the colouring matter is not actually existing in the natural state, but is produced by the heat in the boiling of them by way of preparation, they add that "**Butea** flowers" after a boiling with a dilute mineral acid and subsequent neutralising with Sodium carbonate "give with the different mordants on wool colours which somewhat resemble those obtained from young fustic, namely a terra-cotta shade with chromium, a bright orange shade with aluminium, bright yellow with tin, and a brownish olive with iron. The chromium colour is remarkable by being much redder in hue than the corresponding colour obtained from all other yellow mordant dye stuffs." All the colours on wool were found to be very fugitive to light. The authors therefore added that they could not endorse Sir Thomas Wardle's opinion that **Butea** flowers if cheap enough would be a useful addition to the generally used yellow dyes.

I now pass on to Prof. E. R. Watson's work which is embodied in two papers on "The exact determination of the fastness of the more common indigenous Dyes of Bengal" (*Memoirs Asiatic Society of Bengal*, ii, No. 3, 1907, pp. 25-41, and No. 7, 1908, pp. 155-168). Professor Watson compares safflower red and **Butea** dye with aniline colours by dyeing on cotton and on Mulberry silk. He exposed his dyed tissues to light, soaped them, tried them with acids and also with alkalies.

The results of his experiments with cotton were not encouraging, but with silk he considers **Butea** dye much better.

It is first to be remarked that while Sir Thomas Wardle used the best (and secret) European processes known to him, Professor Watson used the indigenous methods of dyeing—so that while the results of the one indicated the possible, the results of the other indicate the easily attainable.

As a result of his work Professor Watson classed Butea-dye on cotton, both without a mordant and with alum, in his first or least-fast class as regards light, soaping, alkali and acid; and safflower was only better in regard to acid, attaining the third or fourth of his four classes.

The Aniline dyes used for comparison were everyone of them as good or better in every respect except that safflower as regards acid stood above two.

In dealing with silk Professor Watson found safflower much as it was in regard to cotton; but Butea-dye reached the third class in permanence to light both without a mordant and with alum: in

PERMANENCE.

regard to soap if mordanted with alum it reached the third class though it was poor if not mordanted: if not mordanted it was in the second class as regards alkali and in the fourth or firmest as regards acid: when mordanted with alum as regards alkali it was found to be between the second and the third class, and as regards acid in the second class. In these respects it was found to be better than half of the aniline dyes used.

In days past the plain of Palási (Plassey) was covered with **Butea,** the Palas trees; hence its name; and Murshedabad probably got therefrom a very good dye for its silks.

Nyctanthes is the remaining flower dye tried by Watson: but he tried it on silk only. With or without a mordant it fell into the second class as regards light, between the second and third as regards soaping and alkali, and into the third as regards acid.

Report on the colouring matters of the flowers of Thespesia Lampas.

By Mr. A. G. Perkin, F.R.S.

REPORT ON THESPESIA LAMPAS.

The sample consisted of yellow flowers closely resembling those of the cotton plant **(Gossypium herbaceum).** To isolate the colouring matter these were extracted with alcohol, the solution evaporated, treated with water and agitated with ether to remove wax. The aqueous liquid contained a glucoside, but owing to the small amount present, and its soluble nature this has not up to the present been isolated. On digesting its solution with a little hydrochloric acid it is readily hydrolysed with separation of the yellow colouring matter, which was collected, dissolved in a little alcohol, the liquid poured into ether, causing the precipitation of certain impurities. These were removed, the ethereal liquid evaporated to dryness and the yellow residue acetylated, and the acetyl compound after purification hydrolysed in the usual manner.

It consisted of yellow needles which, on analysis, gave numbers according with the formula $C_{15}H_{10}O_7$, and its acetyl compound $C_{15}H_5O_7$ $(C_2H_4O_5)$, also analysed, melted at 189°—190°. These results indicated that this colouring matter was Quercetin, and dyeing and other experiments confirmed this view.

Two hundred and fifty grams of the flowers gave approximately 1·5 grams of quercetin or 0·5 per cent., but as many of the petals were discoloured in the sample here examined, it is likely that in the fresh condition a larger quantity of this colouring matter is present.

REPORT ON THESPESIA LAMPAS.

Dyeing experiments were carried out with this material employing woollen cloth mordanted with chromium, aluminium, tin and iron. The results (patterns enclosed) are fairly good.

As a dyestuff these flowers might perhaps be employed advantageously in the districts in which they abound, but I fear could not compete in this market with better known yellow dyewares.

Report on the colouring matter of the flowers of Hibiscus Sabdariffa.

By Mr. A. G. Perkin, F.R.S.

REPORT ON HIBISCUS SABDARIFFA.

These flowers were treated by a similar method to that employed for those of **Thespesia Lampas,** and were found to contain yellow colouring matter. The yield was poor, 500 grams of the material giving but 1·8 grams of the crude substance.

This product consists of at least two colouring matters; (A) Glistening yellow needles, m.p. about 340—341°C., very sparingly soluble in alcohol, and (B) Yellow needles, m.p. about 295°C., readily soluble in alcohol. The small quantity of the mixed substances which it is possible to obtain, and the loss occasioned during their separation render their accurate examination extremely difficult.

A, I have reason to believe, is an interesting new colouring matter of the flavone group, whereas B, somewhat closely resembles the Gossypetin previously isolated from the flowers of the cotton plant. For instance on acotylation an acetyl derivative, m.p. 224°—226°C., has been obtained from it, which gives numbers similar to those required by acetyl gossypetin, and again the other properties of the two substances are very similar.

I hope to be able to speak more definitely on these points at a later date.

Dyeing experiments with the flowers have been carried out employing mordanted wool and the patterns are enclosed.

The shades are somewhat similar to those given by the **Thespesia Lampas** flowers, but are poorer in character and should the sample of the flowers examined represent the average quality of the material, it can hardly be recommended as a dyestuff for even purely local purposes.

The aqueous extract of the plant possesses a somewhat red tinge, and it was noted that the effect was due to the presence of a small quantity of red sepals. When freshly gathered these, no doubt, would be more numerous, though as the red matter does not dye with mordants and has little effeit upon fabrics, it cannot be regarded as a dyestuff in the true sense.

Postscript.

NYCTANTHES.

Since the above was written a paper by E. G. Hill and Annoda Prasad Sircar on **Nyctanthes** has fallen into my hands. It is entitled "A new colouring matter from **Nyctanthes Arbor-tristis**" and is printed in the *Journal of the Chemical Society*, dxxxix, pp. 1501-1505. The authors describe the dye under the name of Nyctanthin but have not yet proceeded so far with their work that the chemical relationship of the dye to other flower dyes can be stated.

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1908-09 – No. 3

PWÊ-NYET.

(BLACK WAX OF BURMA).

Pwe-nyet and Indian Dammars, by DAVID HOOPER, F.C.S.

INTRODUCTION.

The peculiar resinous substance known in Burma as *Pwê-nyet, Poon-yet,* or *Pwai-nget* was first brought to public notice in 1857. In April of that year Sir Archibald Bogle, Commissioner of the Tenasserim Provinces, forwarded to the Agri-Horticultural Society of India a specimen of this substance procurable at a low cost in those provinces. He informed the Society that he had found it to be a very valuable cement; on softening the material with a little earth oil to the consistence of paint and spread on pieces of cloth and applied to cracks in the roof, it made them quite waterproof. Its properties would render it worthy of further investigation.

Mr. Parish's description.

Rev. C. S. Parish, Chaplain of Maulmain and a member of the Agri-Horticultural Society, was invited by the Secretary to furnish further information as to the nature of the material in question. Mr. Parish's reply, supplemented by the information contained in his letter addressed to the editor of "Science Gossip," in 1866 affords the most exact description of Pwê-nyet that has appeared in any more recent literature.

Pwe-nyet prepared by a bee.

Mr. Parish discovered that it was not a natural resin but the result of the labours of a small bee. He believed Pwê-nyet to be a combination of various gums or resins, probably also of oils, gathered from various sources while in a soft state by the bee and built up and moulded as wax, with this difference, that whereas wax is formed by the honey bee into cells of uniform symmetry, the cells of Pwê-nyet assume no regular form at all. He considered that the resin of the Thingan tree (**Hopea odorata**) formed the chief ingredient while the oleo-resin of the Dipterocarps or wood-oil tree also entered into the composition of the material. The reason

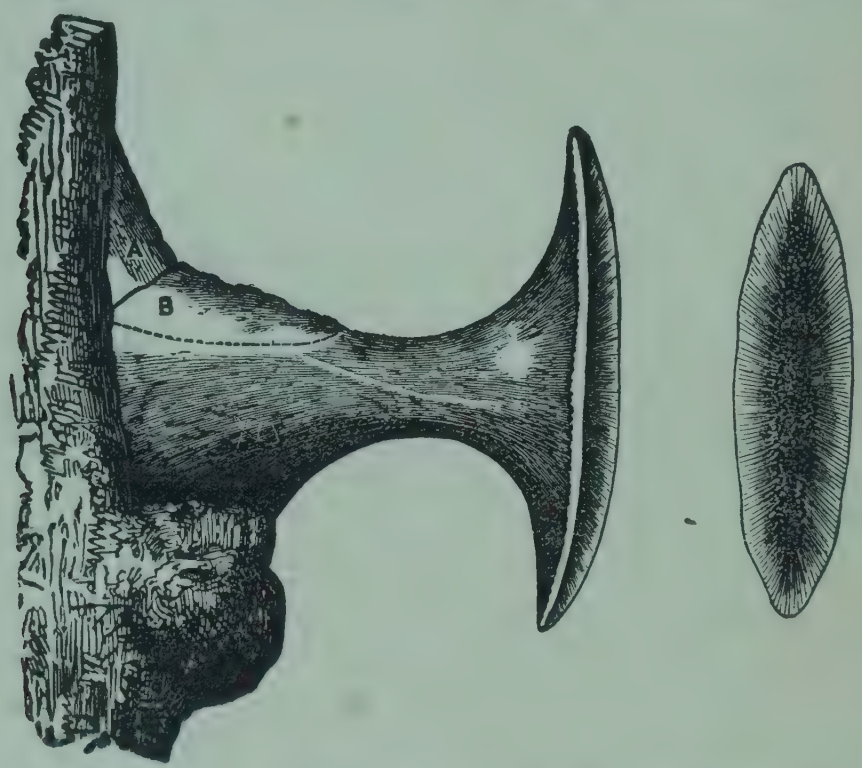
for this assumption was that **Hopea odorata** and **Dipterocarpus lævis** were the principal giant trees of the forests of Tenasserim.

THE NEST OR HIVE.

Mr. Parish then proceeds to describe the nest of the bee, the interesting account and illustration of which are taken from Dr. M. C. Cooke's "Report on the Gums, Resins and Resinous Products of the Indian Museum" (1874).

Description.

"The **Trigona læviceps** builds its nest generally in the hollow of a tree, entering by a small aperture. These apertures are lined with Pwê-nyet, and sometimes only show a small rim of that substance raised above the bark of the tree. Sometimes, however, the bees go on building outside and adding on to the rim until they have formed a wide-mouthed entrance which projects as much as a foot from the tree. These structures commonly assume the shape of the mouth of a large trumpet flattened horizontally, and have a perpendicular diameter of a foot or so, and a horizontal diameter



of three or four inches. They are built with great regularity in their exterior half, but not so regularly towards the base, from the necessity of adapting the structure to the shape of the tree where the hole may chance to be. They are very curious and pretty objects, but being very prominent, attract the notice of the passers-by, and so often lead to the spoiling of the habitation. I send a rude sketch of one of these trumpet openings. The drawing, one-sixth the natural size, is an imaginary restoration. The portion marked A forms the specimen herewith forwarded, showing the ordinary texture, colour and general appearance of Pwê-nyet as it

is found in the jungles. B within the dotted line marks the space over which the blind cells, presumably for strength, extend. From the shape of the base the mass must have rested partly on some such excrescence of the trunk as is represented. The actual entrance into the tree in this instance was by a very narrow perpendicular slit two and a half inches long and three-tenths of an inch wide, the upper part of which may be seen in Fig. 2. The width laterally in the middle of the stem of the structure is exactly one and a half inch. The weight of the whole is probably half a pound. What the internal economy of the nest is I cannot say, as the tree has commonly to be felled in order to obtain the contents. I am informed by the Burmese that from five to ten viss (18·25 to 36·5 lbs.) are usually obtained from one nest."

THE NEST OR HIVE.

Yield of one nest.

A more recent account of the formation of the nests yielding Pwê-nyet was contributed to "Capital," September 1907, by A. M. S[awyer], an experienced resident in Burma.

"In the evergreen forests of South Tenasserim the Kanyin (**Dipterocarpus turbinatus**) is tapped for its oleoresin. The method employed consists of the excavation, by means of narrow long-bladed adzes, near the foot of the tree or a little above it of deep hollow cavities extending into the wood of the trunk for a foot or more. To stimulate the flow of resin into these cavities, their bases, roofs and sides are fired. When the resin by this means accumulated in the cavities will have been ladled out and collected, their charred and resin-clogged edges and surfaces, after being re-cut, are burnt again. These operations are regularly conducted at suitable intervals throughout the tapping season, at the close of which the tree is left to recuperate for a period of years. In course of time the gaping cavities are covered over by the growth of new wood, but not before the irritation caused by the festering wounds will have long since led to the formation of spacious hollows in the trunk when as it often happens the approximation of the edges of the callosity is so complete as to leave spaces between them, insects such as ants and bees find admittance to the hollows beyond. Thus it is that closed hollows offer some of the most ideal natural conditions for the installation of hives of sorts. The hollows that form in the stems and branches through natural decay consequent on age or as the result of irritation or injury also afford shelter to bees.

Description in "Capital."

"The presence of the hives of pwê-nyet bees is revealed by the truncate-conical or cylindrical resin tubes constructed around their

Tubes of resin.

THE NEST OR HIVE. narrow entrances. These tubes are constructed of pellicles of nearly transparent resin combined with minute grains of masticated wood and bark, sand, clay and the like. The lower and older portions of the tubes are brittle and admit of its being easily detached, while their upper ends are soft and sticky. When they are broken or removed the tubes are speedily mended or re-constructed, so that the hives, if ever, are seldom without them for any length of time. The hives themselves, placed well in the interior of the hollows, are constructed of dense masses of pwê-nyet. The cells that vary from one to two inches in length and one and a half inches in diameter each, are ovoid-oblong flattened structures which, though smooth-walled within, lack the regular shape, order or precise arrangement so much admired in those of the common honey bees. They are out of all proportion to the size of the insect, the young of which swarm on the inner sides of the drier cells. Varying with

THE HONEY. their age the cells contain honey of varying flavour and strength, the sweetest liquor is held in the newest and the most astringent and bitter in the oldest cells."

The Insects.

THE INSECTS. Specimens of the insects forming Pwê-nyet near Maulmain were sent by Mr. Parish to Calcutta in 1857, and at the suggestion of Mr. W. S. Atkinson, Secretary of the Asiatic Society, they were forwarded to Mr. F. Smith of the British Museum for identification. Mr. Smith identified them as **Trigona læviceps,** originally

Identification. described from Singapore. Mr. Smith's description* is as follows: —**Trigona læviceps.** Worker, $1\frac{1}{2}$ line. Head and thorax black: the face, above the insertion of the antennæ, smooth and shining; the antennæ rufo-testaceous; the clyperus with a hoary pubescence; its anterior margin, and also the mandibles, ferruginous, thorax smooth and shining, the meta-thorax highly polished, the wings subhyaline and iridescent, the stigma and nervures ferruginous. Abdomen ferruginous, smooth and shining. Habitat, Singapore.

Reference in Fauna of British India. In Blandford's Fauna of British India (Hymenoptera), Vol. I (1897), 561, by Lieutenant-Colonel C. T. Bingham, **Trigona læviceps,** Smith, is referred to under the synonym **Melipona læviceps,** Dall., and is said to be a common species building its nest often in crevices in the brickwork of the walls of houses. The dammar-bees, as the species of this genus are sometimes called, are

* Catalogue of the Hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca, and at Singapore. By Frederick Smith, Assistant in the Zoological Department in the British Museum. *Journal of the Proceedings of the Linnean Society (Zoology)*, Vol. ii (1858), 42—130.

widely spread, being plentiful in South America and in the Oriental region. All build their nests in hollows of trees, crevices among rocks and sometimes in holes of stone walls. The species of this genus and also of its ally, **Melipona**, are destitute of stings. THE INSECTS.

Melipona læviceps is not the only dammar-bee that manufactures this peculiar resin in Burma. "A.M.S.," a portion of whose article has already been quoted, says: "Besides the commoner species of Apis which construct hives yielding honey and wax, there are at least four distinct stingless species of the same or of closely allied genera that engage in the comparatively laborious production of pwê-nyet as well as in the secretion of more or less honey. These are found in both In and Kanyin forests and are known in Burmese as (1) *Toung-zon-byu*, (2) *Anet*, (3) *Wa-pan-ma* and (4) *Myit-hmwe-lain*....(1) is a black, robust insect, one-third of an inch in length, the lower halves of the wings of which are white and glistening; it builds small hives of brown pwê-nyet of good quality. (2) is a black insect which builds the larger size hives with yellow pwê-nyet of the best quality; economically this product is the most valuable. (3) is a yellow bee constructing large hives like (2), the pwê-nyet itself resembling that of (1). (4) is a small yellowish-brown bee building a small hive of black sticky pwê-nyet of inferior quality. In the hives of these insects, it will be seen that pwê-nyet takes the place of wax, probably because either the insects, unlike the common honey bees, are not endowed with the capacity of excreting, or because the quantity of it excreted is insufficient for the purpose of hive construction, or again because its quality is such as to preclude the possibility of its application thereto." Four kinds of bees. The resin hive.

These small stingless and dammar bees are also known in other parts of India, and certain of them with the analyses of their wax are referred to in *Agricultural Ledger* No. 7 of 1904 entitled "An Account of the Sources, Preparation, Trade and Composition of the Bees'-wax of British India." These insects are known under the following vernacular names:—*Kunti, kote, poye, nasari, pove*, BOMB.; *Bhinkwa, bhumkua, bhungaira*, UNITED PROV.; *Bankura*, PB.; *Misri, misri-jiga, misri-jen, sollejenuhula*, KAN.; *Kota, kuntali, lokhra*, CENTRAL PROV.; *Nasri theni, kosutteni*, TAM.; *Musuru-teniga, musari egalu*, TEL.; *Moye byah*, BURM.

The wax is regarded of poor quality and is only used locally. In the Central Provinces the wax of the Kota bee * is sold at the Description of wax and honey.

* Probably **Melipona cacciæ** (see Major C. G. Nurse, A new species of wax-producing bee. *Journ. Bomb. Nat.-Hist. Soc.*, xvii, 1907, p. 619).

INDIAN DAMMAR BEES.

low rate of two to four annas (2*d.* to 4*d.*) a seer (about 2 lb.), because it is darker in colour and more sticky than ordinary yellow bees'-wax. The honey of these bees is often tainted with a peculiar odour and bitterish and acid taste, and has a considerable reputation in many parts for its medicinal properties. In Nellore the honey is regarded as intoxicating.

A species of dammar bee, **Trigona ruficornis,** Smith, is thus described by Mr. Horne in the *Journal, Zoological Society,* Vol. VII, 185:—

Trigona ruficornis.

"This is one of the smallest honey-bees I have ever met with, and its habits are curious. I noticed it under the following circumstances, and I never again met with its nest, although the natives all know it. One evening, at Benares (April 4, 1863), as

Benares.

I was standing at my door I saw a swarm of from 400 to 500 of what I took to be midges rapidly flying about in a mazy kind of dance, occupying a space of five or six feet, and being about ten feet from the ground. I brought out my insect-net and caught about a hundred in one sweep, when, to my surprise, they proved to be bees. On watching them I observed that they went in and out of a little hole in the wall close by, under a beam where was a hollow, and that many of their thighs were laden with pollen.

Habit of insect.

"The insects seemed quite harmless, walking about my hand and not attempting to sting. Digging out some bricks with care, I came on a portion of their nest. The space it occupied appeared to have been originally eaten out by Termites. It was coated on all sides with a layer of black wax, and in it was stored their honey. The waxen cells were of a dark brown colour and very globular, pendent side by side from the roof, and not, as far as I could see, arranged hexagonally.

"The honey was very dark in colour, but excellent in flavour, and I was told by the natives that it possessed medicinal qualities. It had a slight astringency and, considering the size of the insect, the quantity stored was very large. I was also told that these insects commonly use hollow trees, in which they store astonishing quantities of honey, which is diligently sought for and highly prized. They called them "Bhonga," which appears to me to be a generic name for all bees in the North-West Provinces. Large bricks prevented my digging further, so that I cannot describe their breeding cells."

Malabar.

Major-General H. R. Morgan in *Forestry in South India* (124) refers to the occurrence of these insects in Malabar. "**Trigona**—a very minute bee which builds in the crevices of walls,

etc. The globular cells are built of a mixture of various substances which I have seen these little creatures collecting from **Mesua, Calophyllum, Canarium, Artocarpus,** and other trees. It resembles cobblers' wax in appearance. The amount obtained from each hive is very small, about half a pound or so." THE INSECTS.

These bees are also known in the Malay Peninsula. In the *Agricultural Bulletin of the Straits Settlements* (Vol. VII, No. 2, February 1908, 40) a description is given of a varnish obtained by the Malays from a jungle tree, **Garcinia merguensis,** Wight. "Notches are made in the bark at 5 p.m., and the gum-resin is collected early next morning before the little bees, known as Keluent (**Trigona**), can come to secure the resin and build their nests." Straits Settlements.

In Trinidad species of **Trigona** were observed to carry off the rubber fluid from the stems of **Castilloa elastica,** and the gum-resinous exudation of the **Garcinias,** as a sort of ready-made wax for their nests. In some cases they actually cut the bark to cause a flow of the desired fluids. Trinidad.

It is hoped that a determination of the various species of **Trigona** and **Melipona** in India will in due time be made; and it will be interesting to observe what special resinous secretions are preferred by each species of the insect.

Trade.

In the returns of exports from the port of Rangoon for 1867 it is shown that 1,000 viss (=3,650 lbs.) of poungit, dammar or tamah were sent to Maulmain, Akyab, Tavoy and Mergui. Trade in 1867.

For the year 1866-67 the following quantities were exported from Maulmain:—

	Cwt.	Rs.
Rangoon	16¼	75
Tavoy	68	303
Mergui	9¾	45

In addition to the exports from Maulmain poungit or dammar was imported from Rangoon and Penang, but as the article from Penang was one-quarter of the price of that from Rangoon, it is to be inferred that the Straits dammar resin and not pwê-nyet was indicated. Mr. Parish pointed out that mistakes of this nature were often made owing to the fact that the name dommar or dammar was given to Burmese pwê-nyet in the bazar by the natives of India. Exports.

USES. The right of collecting pwê-nyet is sold annually by the local Government in Tenasserim and other parts of Burma, and this forms one of the sources of revenue under Minor Forest Products.

A minor forest product. In the Burma Forest Report for 1899-1900, 10,530 viss (343·16 cwt.) of dammar were collected from the unclassed forests of the Tenasserim Circle and realised Rs. 1,985 (£132 6*s.* 8*d.*). In 1900-1901, 11,824 viss (385·33 cwt.) were removed and valued at Rs. 2,073 (£138 4*s.*). In 1906-07 the value of the dammar rose to Rs. 4,200 (£280). If this product may be taken as pwê-nyet, the price is 3 annas (3*d.*) per viss (3·65 lbs.) or Rs. 5-8-0 (7*s.* 4*d.*) per cwt. The selling price in Rangoon is four to eight annas (4*d.* to 8*d.*) per viss.

Uses.

USES. The principal use of pwê-nyet in Burma is for caulking boats. For this purpose it is mixed with earth oil or petroleum. The method is to boil the material in water which makes it quite soft,

Caulking boats. and then to knead it with a certain quantity of petroleum until it attains the consistency of a lump of putty which it much resembles. In that state it is very viscid and tenacious and is ready for use. It may be seen in all the boat-builders yards in Pegu for luting the

Waterproof material. joints of new boats and repairing old ones. It may also be applied to cracks in the roofs of houses to render them waterproof in the rains, and to wooden floors and boxes. The mixture of pwê-nyet and earth oil is used for painting over Burmese umbrellas.

Cement. In South India black wax is used for water-proofing the powder-pan of matchlocks, and for fixing the mouth-pieces of Indian bagpipes made with two reeds and a gourd.

Resembles shellac. If better known it might be used more extensively in the arts and industries of the country. The superior grades are light in colour and would be suitable for white varnishes and polishes. Old and dry samples resemble shellac and could be utilised for sealing wax and cement.

Examination of samples.

EXAMINATION. Pwê-nyet as sold in the bazar is commonly in irregularly shaped lumps, tough and plastic in the hands, and readily softening when warmed. According to its quality it is black and dirty, brown, or light coloured like yellow wax. Fresh samples have a faint aromatic

Description of samples. odour. On exposure it becomes hard dry and brittle, and loses its aroma. The specific gravity is 1035.

EXAMINATION.

The following samples in the Indian Museum were examined:—

1. No. 16962. Pwê-nyet from In tree (**Dipterocarpus tuberculatus**). Brown solid and brittle resin, consisting of the trumpet-shaped openings of the nest. From Pokokko.
2. No. 22888. Pwê-nyet from Amherst District. Black resinous mass, tough in consistence.
3. No. 28441. Inferior quality from Maulmain. Blackish-brown tough mass with visible impurities.
4. No. 28442. Superior quality from Maulmain. Light yellow mass enveloped in leaves.

The following constants were obtained:—

	1	2	3	4
Moisture	2·8	5·6	3·5	3·2
Ash	1·0	7·3	14·8	·3
Soluble in alcohol	65·0	72·0	69·3	86·2
„ „ ether	81·1	61·9	60·1	72·2
„ „ petr. ether	41·9	65·5	58·8	70·3
Acid value	32·2	26·2	30·8	28·3
Ester value	56·3	24·1	24·2	23·9
Saponification value	88·5	50·3	55·0	52·2
Iodine value	52·0	105·3	104·7	137·1

The samples agree in being only partially soluble in the usual volatile liquids and in possessing a low acid value. The wax of the true pwê-nyet samples melted between 70° and 80°. The portion dissolved by alcohol was an amber coloured resin melting between 90° and 100°, the portion insoluble in alcohol and other volatile liquids was a white brittle resinous substance melting between 190° and 200°. The solid resin forming the opening of the nest gave a soluble brown resin melting at 130° and an insoluble white resin melting at 180°. Whether this resin is merely pwê-nyet dried by exposure or a substance of different origin can only be determined by comparing its properties with those other samples of resin of known botanical source. The disappearance of aroma in the hard resin, and its low iodine value compared with that of soft pwê-nyet indicate a loss of volatile oil either through evaporation or oxidation. That pwê-nyet in the fresh state does contain an oil may easily be seen by warming a small quantity in water when a film of oil appears on the surface.

Resins

Loss of oil.

The solubility and chemical constants of pwê-nyet might be the means of explaining its origin, since as far as our information goes

Origin of resin.

EXAMINATION. the resin is obtained from various trees. Dr. McClelland remarked that it was yielded by the **Shorea robusta** or Saul tree of India. This mistake was afterwards corrected and it was supposed to be the "pure unadulterated gum or resin of **Canarium strictum,** only bored and channeled by the bee." Mr. Parish, as recorded above, was inclined to the opinion that pwê-nyet consisted of the resin of **Hopea odorata** mixed with the oil of various dipterocarps or wood oil trees, particularly of **Dipterocarpus lævis**. The dried resinous openings of the nest have been sent to the Indian Museum as the resin of **D. tuberculatus,** from the fact of the nest being attached to that tree. The chemical nature of Burmese black wax has apparently never been examined nor indeed are there any published analytical constants of those resins known as dammars whose botanical origin has been determined. It seems, therefore, necessary in the first place to define the distribution of the Indian dammar trees and then give some comparative chemical tests of their resinous secretions, which are frequently confused one with another, to see to what extent they agree or differ.

Shorea.

Canarium.

Hopea.

Dipterocarpus.

INDIAN DAMMARS, BOTANICAL SOURCES. The dammars likely to be used by the **Melipona** in the preparation of Burmese black wax do not include the so-called East Indian dammars exported from Singapore, the origin of which is mixed and not sufficiently known, but to those of the more restricted area of British India. These special dammars which are referred to in works on Indian products and whose properties will now be described are obtained from the following botanical sources:—

Nat. Order Dipterocarpaceæ.

Dipterocarpus spp.
Shorea robusta, *Roxb.*
Shorea obtusa, *Wall.*
Hopea odorata, *Roxb.*
Hopea parviflora, *Beddome.*
Vateria indica, *Linn.*

Nat. Order Burseraceæ.

Canarium bengalense, *Roxb.*
„ **resiniferum,** *Brace.*
„ **strictum,** *Roxb.*

Dipterocarpus spp.

Dipterocarps The dipterocarps are lofty trees of tropical East Asia of which 17 species grow in India. They are known by yielding an oleo-resin

INDIAN DAMMARS.

or wood oil which has many useful properties and is used in the arts and medicine. The wood oil is of two kinds, Gurjan or Kanyin, a clear dark coloured oil containing 30 to 40 per cent. of volatile or essential oil, and In or Eng, a thick honey coloured granular fluid with a smaller proportion of essential oil. Gurjan oil is derived from **Dipterocarpus alatus,** *Roxb.*, found in Chittagong, Burma and the Andamans; **D. turbinatus,** *Gærtn.*, found in the same regions; **D. lævis,** *Ham.*, of Burma, and probably other species. In resin is derived from **D. tuberculatus,** *Roxb.*, and **D. obtusifolius,** *Teysm.* In the collection of the oleo-resin from the trees hardened resin often forms near the artificial openings made in the trunk, and occasionally flows down the bark and sets in stalactiform masses. This is removed and sold separately. In the Prome division of Burma the In resin is boiled in a pot with about 15 per cent. earth oil, an operation which drives off the volatile oil and leaves a hard resinous mass used for caulking boats.

Gurjan oil.

In oil.

Samples of a dipterocarpus resin are sold in the bazar in Rangoon and Maulmain having a reddish-brown or dark brown appearance and occurring in stalactiform masses as if it had hardened on the trees. The names In-tsi and In-dwe indicate the natural exudations of **D. tuberculatus,** as being the chief source of the solid commercial resin.

Examination of Samples.

Examination and constants.

1. Dipterocarpus resin. Old sample.
2. Resin of **D. lævis,** Burma.
3. Resin of **D. alatus,** Chittagong.
4. Resin of *Dholia* Gurjan tree, Chittagong.
5. Soft resin of **D. obtusifolius,** "In kohe."
6. Soft resin of **D. turbinatus,** "Kanyin kohe."
7. Resin of **D. tuberculatus,** "Indwe", Maulmain.
8. Soft "Red varnish," from In tree, Burma.

	Soluble in alcohol.	Acid value.	Ester value.	Saponification value	Iodine value.
1	52·0	24·7	44·4	69·1	49·2
2	62·0	35·9	38·0	73·9	53·3
3	62·8	44·4	64·2	108·6	74·8
4	14·5	6·2	38·2	44·4	69·6
5	97·3	17·3	24·7	42·0	128·5
6	95·1	14·8	34·5	49·4	107·6
7	41·7	30·8	41·3	72·1	50·8
8	90·0	23·6	16·5	40·1	114·0

SHOREA RESINS.

There is a great variation in the solubility of these samples in alcohol, showing that the oleo-resins or soft resins are much more so than the indurated resin containing little essential oil. The high iodine value at once distinguishes those samples in which the oil is present. The sample of hard pwê-nyet forming the opening of the nest agrees in most respects with the dried resins, Nos. 1, 2, 3, and 7. The soft commercial pwê-nyet would partake of the character of a substance formed by a combination of the oleo-resin with the dried resin of the dipterocarps. The average results of the examination of a limited number of museum specimens to some extent prove this, but the question can only be satisfactorily settled by examining a series of carefully collected field samples.

Shorea robusta, *Roxb.*

Shorea.

The Sál tree is found in the Tropical Himálaya and along its base from Assam to the Sutlej: the eastern districts of Central India and the Western Bengal Hills. The tree is not recorded from Burma by Kurz. The Burmese species is

S. obtusa, *Wall.*

Common in the In forests from Ava, Prome and Martaban down to Tenasserim, up to 2,000 ft.

Names.

The resin is known as Rál, Dhuna and Sál-dammar, and was called Resina Bengalensis in old medical works.

Resin formerly abundant.

Rál was formerly procured in considerable quantities from the Sál forests along the northern frontier of Oudh. In Bengal it was collected in Lohárdagá (including Palámau), Singbhúm, Mánbhúm and was probably imported from the forests of the Morung on the Nepál frontier. In Cuttack it was produced in the Hill States of Pal Lahára and Tálcher of the Tributary Maháls. The Khonds (Kandhs) and Wodeyas wounded the trees in several places. The resin issued from the wounds and was collected when sufficiently solid. The probable quantity annually collected in Orissa was said to be about 6,000 maunds (220 tons) which found their way to Cuttack and Balasor, nearly the whole of which was exported to Calcutta. The market price varied with the quality from Rs. 4-4-0 to Rs. 6 (5*s.* 8*d.* to 8*s.* 0*d.*) per maund (82 lbs.), near the forest, and Rs. 10 to Rs. 16 (13*s.* 4*d.* to 21*s.* 4*d.*) per maund in the towns. The retail price now in Calcutta is now about one rupee (1*s.* 4*d.*) a seer (2·06 lb.).

SHOREA RESINS.

Forest restrictions over *Sal* trees.

Sál resin was at one time the chief commercial resin in Bengal and the Central Provinces. The falling off that has taken place in its supply in the market is owing to the conservancy of the Sál forests and the adoption of other resins, chiefly pine resin, in its place. The process of extraction is most injurious to the trees and as these forests are now strictly preserved on account of the timber, the extraction has been prohibited. Until 1867 the resin was exported from Nepál into Oudh, but owing to the introduction of new forest laws by the State the exports were prohibited as in other parts of India.

Description of resin.

Sál resin occurs in brittle stalactitic pieces of a pale creamy yellow colour, nearly opaque, to a rich brown colour more or less transparent. The darkest coloured resin is that obtained from decayed portions of the tree. Each piece has a striated appearance as if the resin had run out in thin liquid streams which had hardened on the surface one over the other.

USES.

Rál or dhuna makes a good substitute for pitch, and is used as varnish by carpenters, but its consumption at present is chiefly confined to burning as incense and as medicine. It is in constant use during the ceremony of cremation at the burning ghâts throughout Bengal. One-quarter of a seer (half a pound), costing one anna, (1*d.*) is the prescribed quantity of dhuna or incense added to the fuel in the burning of a body.

Examination of samples.

Examination and constants.

1, 2 and 3. Old samples of unknown origin.
4. From Kámrúp, Assam.
5. "Rál Sakhu," United Provinces.
6. "Sál dhup," Nepal.
7. "Sál dhup," Puri.
8. **Shorea** resin from Buxár Duárs.
9. Sál dammar, Dárjiling Terai.
10. "Thitya" (**S. obtusa**), Pyinmana, Burma.

1 Dark brown, clear, with impurities. 2 Brown, transparent, stalactitic pieces. 3 and 4 Orange brown opaque masses. 5 Small, dull, light brown translucent pieces. 6 Ochreous, porous and friable masses. 7 Similar to 5. 8 Similar to 7, but more opaque. 9 Mixed rich and dull brown, transparent and opaque. 10 Dull light brown nummulitic masses.

SHOREA RESINS.

	Soluble in alcohol.	Acid value.	Ester value.	Saponification value.	Iodine value.	Ash.
1	56·7	29·1	103·4	132·5	50·8	4·1
2	58·1	34·0	67·1	101·1	52·0	·2
3	51·2	38·9	103·3	142·2	51·4	·7
4	62·0	48·6	84·0	132·6	49·7	·8
5	53·2	38·9	88·8	127·7	54·5	2·3
6	55·7	46·1	55·1	101·2	55·9	·2
7	55·4	36·4	86·5	122·9	52·0	·3
8	54·5	36·5	67·1	103·6	55·1	·7
9	53·9	34·0	74·4	108·4	53·4	·7
10	59·3	46·2	86·4	132·6	50·6	·4
Average .	56·0	38·8	81·6	120·4	52·5	1·0

The results of the chemical tests are fairly uniform. It is interesting to observe that the resin of the Burmese species of **Shorea** bears a strong resemblance in its characters to the Rál of North India. It is also interesting to notice that the resin of Dagging (**Shorea leprosula,** *Miq.*), a Singapore dammar, has a similar constitution. A sample sent by Mr. H. N. Ridley in 1905 possessed a solubility of 50·4 per cent. and an acid value of 36·2.

Hopea odorata, *Roxb.*

Hopea. Rock Dammar (Eng.) *Thingan* (Burm.). The tree grows all over Burma from Chittagong and Martaban to Tenasserim; also in the Andamans.

H. parviflora, *Beddome.*

Rock dammar. A large handsome tree common in the forests of Malabar and South Kánara, up to 3,500 feet.

Rock dammar was brought to the notice of the Agricultural Society of India in 1858 by the Rev. C. S. Parish who remarked that the pure white resin might be turned to many useful purposes and was procurable in large quantities. Dr. Barry examined the resin and reported that it was partially soluble in spirits of wine and perfectly so in benzol or oil of turpentine; the varnish was clear and limpid and dried almost instantaneously. Dr. M. C. Cooke

Description. in his report dated 1874 described its properties as follows: "The resin occurs in nodules about as large as a walnut, rounded, of a pale straw colour, sometimes almost colourless, brittle, with a shining resinoid fracture, scarcely distinguishable in appearance from the East-India dammar of the London markets. The London brokers class it as copal and value clear pale samples at a rate equal

VALUE. to that of East-India dammar, *viz.*, about 40*s.* per cwt."

SHOREA RESINS.

Later value.

The Reporter on Economic Products has lately obtained further information about the collection and use of rock dammar in Burma, and, through the Imperial Institute, a more recent valuation in the London market. Thingan is abundant in South Tenasserim especially in the Ma-lí-won sub-division. The resin exudes out of fissures in the bark during the dry weather, either by itself or from wounds made in the tree. No special methods are used for procuring a flow of resin. 3,000 or 4,000 viss (10,950 or 14,600 lbs.) could be collected in one year, at the rate of 4 annas (4*d.*) a viss = 3·65 lbs. The cost of cleaning and packing would cost one or two annas per viss extra. The dammar is not sold in the bazar, but is used locally in the arts and medicine. The fresh resin is used for caulking boats, as it liquifies on heating and hardens immediately on cooling. In Tavoy it is employed by Burmese artists for painting pictures. It is supposed to have medicinal qualities and native doctors use it for sores and ulcers; it is administered by mixing the powdered resin with honey and charcoal and applying it to the wound.

USES.

Variety of dammar.

An examination of the resin of **Hopea odorata** made at the Imperial Institute in 1903 indicated that it may be classed among the better varieties of dammar resin: a firm of varnish makers in London reported that it would be regarded as a second quality dammar, and that it could be used for the preparation of "Paper" or "Crystal" varnishes, such as are employed for indoor decorative work. Its value was about £2 5*s.* per cwt. The result of the enquiry was that as a commercial product the resin has a certain though somewhat limited demand at remunerative prices.

Examination of samples.

Examination and constants.

The following samples in the Indian Museum were chemically examined:—

1. Old sample.
2, 3 and 4. **Hopea** resins from Tenasserim.
5. Resin of **H. parviflora,** from South Kanara.

	Soluble in alcohol.	Acid value.	Ester value.	Saponification value.	Iodine value.
1	74·7	28·4	38 3	66·7	91·8
2	74 9	28·4	33·4	61·8	96·3
3	76·1	33·3	43·3	76·5	90·6
4	71·5	35·8	25·9	61·7	98·4
5	74·8	40·8	33·3	74·1	84·4
Average	74·4	33·3	34·8	68 1	92·3

HOPEA RESINS.

The melting points of the original resins were 99° to 110°; of the soluble resins, 80° to 100°; and of the insoluble resins, 152° to 178°. The samples of **Hopea** resin are more soluble in alcohol than those of the **Shorea** and the indurated resins of **Dipterocarpus.** The saponification values of the **Hopea** resins are higher than those of the **Dipterocarpus,** and lower than those of the Sál, while the iodine values of the **Hopea** resins are higher than both the others. Here again may be noticed the agreement in chemical characters between the resins of different species of **Hopea** growing in widely separated localities.

Vateria indica, *Linn.*

Vateria indica.

A large evergreen tree of the Western Peninsula from Kanara to Travancore, ascending 4,000 ft.

South India.

The exudation of this tree is called White Dammar of South India, Piney resin and Indian Copal. The tree is known locally as Dupada and Pinne, and the resin as Vellai-Kungiliam.

Three forms of resin.

Piney varnish is obtained by making notches in the tree, when it exudes in a liquid state and gradually hardens. According to the Jury Report of the Madras Exhibition, 1857, it occurs in three forms: 1st Compact Piney resin; 2nd Cellular Piney resin; and 3rd Dark coloured Piney resin. The better varieties are dull or bright, orange or yellow to amber coloured masses, breaking with a bright vitreous fracture. It was examined about 40 years ago by Mr. Broughton of Ootacamund, who reported that it surpassed copal in its greater solubility, and its varnish dried with great purity and whiteness.

Not commercially important

The resin could be obtained at about Rs. 6 (8*s.*) per maund of 25 lbs., but it is not an article of any commercial importance. It is frequently confounded with East-Indian Dammar, such as the sundras resin from Zanzibar and dammar resin from Singapore. It is used chiefly as incense, for varnishes and in medicine. Given in the form of powder it is said to check diarrhœa. The fresh resin combined with oil is occasionally made into crude candles.

Examination of samples.

Examination.

Some of the samples of this resin in the Indian Museum are evidently those of imported dammars from the Straits and Zanzibar. It has been noticed in many works on Indian products that **Vateria indica** has been used as a convenient name under which to place descriptions of and information on all dammar resins in general.

VATERIA RESINS.

After rejecting those not sufficiently authenticated, the following four were selected for analysis:—

1. **Vateria indica** resin from Madras.
2. White dammar from South Kánara.
3. **V. malabaricum** resin from Madras.
4. **Vateria** (?) resin from Madras.

Nos. 1 and 3 were orange yellow stalactiform pieces, transparent with opaque portions.

2 clear light yellow with glassy fracture.

4 orange yellow somewhat opaque.

Constants.

	Soluble in alcohol.	Acid value.	Ester value.	Saponification value.	Iodine value.
1	61·7	24·7	56·8	81·5	62·1
2	50·9	42·0	46·9	88·9	61·5
3	59·4	39·5	34·6	74·1	63·2
4	69·3	77·8	3·7	81·5	60·5
Average .	57·3	35·4	46·1	81·5	62·2

The average result of constants is calculated from the first three samples, the fourth not being sufficiently authenticated and having a higher acid value.

Canarium resins.

Canarium bengalense, *Roxb.*

A tall tree met with in the Eastern Himálayas, Sylhet and Assam.

C. resiniferum, *Brace MSS.*

Assam [*Journ. Asiatic Society Bengal,* lxii (1893), II, 4, 188].

C. strictum, *Roxb.*

Black Dammar tree. Resin: *Karapu-Kongiliam,* Tam. Common in Tinnevelli and Kánara in South India.

Black Dammar.

The resins of these widely distributed trees have a similar appearance. It occurs in black shining masses, but when held up between the eye and the light it is transparent and has a deep brownish-yellow or amber colour. It is not unlike copal, but the natives set little or no value upon it. In Dr. Roxburgh's time in

Description.

CANARIUM RESINS.

the Calcutta bazar it was only valued at two or three rupees (2*s.* 8*d.* to 4*s.* 0*d.*) a maund (82 $\frac{2}{7}$ lbs.). It is used as incense by the Lepchás in Sikkim, where it is known as *Googal dhup*.

USES.

In South India black dammar was formerly obtained by the destructive method of cutting gashes in the lower part of the stem and then setting it on fire. There is a small trade in the article and it is used in the manufacture of bottling wax and varnishes. It was examined by Mr. Broughton who found that though insoluble in spirit, its solution in turpentine formed a tolerable varnish. In its possible applications it however possesses few advantages over ordinary resinous substances. Its price on the Malabar Coast, Rs. 8 (10*s.* 8*d.*) per 25 lbs., is about ten times the price in England of common rosin which sold for 7*s.* 6*d.* per cwt.

Value.

One or two correspondents in Assam having lately enquired about a possible trade in **Canarium** resin, the Reporter on Economic Products procured through the Imperial Institute a further valuation and opinion regarding the resin in the London market. A firm of varnish makers reported that the resin was suitable for the preparation of a hard drying varnish, such as is required in the preparation of enamel paints. The dark colour of the resin would, however, to some extent prejudice its sale, and it was unlikely that a higher price than 18*s.* per cwt. would be obtained for it.

Not a profitable product.

The Deputy Commissioner of Forests reports that **Canarium bengalense** is not gregarious and is scattered over a large tract of country, and this circumstance enhances the cost of collection. The resin is estimated to cost 6 as. (6*d.*) per seer (2·06 lbs.) or Rs. 15 (20*s.* 0*d.*) per maund, (82 $\frac{2}{7}$ lbs.) equal to 28*s.* per cwt. Adding to this the freight to Calcutta and London, it is evident that there would be a considerable loss in any attempts to commercially exploit the article.

Local opinion.

A large sample of the resin was supplied to a Calcutta firm of paint and varnish manufacturers to ascertain if there was any local demand for it. The manager, after testing the sample, replied that it yielded a poor quality of varnish and left a considerable quantity of residue. He added, "The sample is not equal to Gum Dammar which we import from Singapore at a cost of Rs. 48 (64*s.*) per cwt. from which a clear varnish is obtained and leaves no residue."

The unfavourable opinion agrees with that expressed by Dr. Roxburgh in "Flora Indica" about a hundred years ago. It only remains therefore to ascertain how **Canarium** resin compares in composition with the Indian dammars previously discussed.

Examination of samples.

CANARIUM RESINS.

Examination.

Of the samples examined in the Indian Museum, two were of **C. strictum,** one of **C. bengalense,** and one of **C. resiniferum.** The two remaining samples were sent under other names, but their appearance and properties betrayed them as black dammars.

1. **C. strictum,** Tinnevelli, Madras.
2. "Karruppu kungiliam," Cumbum, Madras.
3. **C. bengalense,** "Dhuna," Jorhát, Assam.
4. **C. resiniferum,** "Karail," Cachar.
5. Sent as resin of **Aquilaria Agallocha,** Golághát.
6. Sent as **Vateria indica** resin, South India.

Description.

The specimens were all brown or dark brown, transparent, brittle resins.

Constants.

	Soluble in alcohol.	Acid value.	Ester value.	Saponification value.	Iodine value.
1	12·9	6·2	35·8	42·0	45·1
2	18·2	7·4	37·0	44·4	45·1
3	23·1	8·6	33·4	42·0	41·8
4	11·9	6·2	43·2	49·4	46·7
5	13·9	5·6	41·3	46·9	42·2
6	24·6	8·6	28·5	37·1	43·5
Average	17·4	7·1	36·5	43·6	44·0

In this resin the solubility and other constants are lower than in all the other Indian dammars.

Summary.

SUMMARY.

The examination of these resins has not been very exhaustive but the application of a few simple analytical tests has resulted in showing that each exudation from a generically botanical source has distinguishing properties. A table of the average constants will show how they vary. The difficulty connected with the dipterocarpus resins on account of their variability was settled by taking the average of Nos. 4 and 5 as these samples had been freshly collected from trees which were identified in 1904 by Lieutenant-Colonel D. Prain at Sibpur. Accepting these as representative,

Dammars have peculiar constants.

SUMMARY. and arranging the averages according to their solubility, the following interesting table results:—

	Soluble in alcohol.	Acid value.	Ester value.	Saponification value.	Iodine value.
Dipterocarpus .	96·2	16·0	29·7	45·7	117·7
Hopea . .	74·4	33·3	34·8	68·1	92·3
Vateria . . .	57·3	35·4	46·1	81·5	62·2
Shorea . . .	56·0	38·8	81·6	120·4	52·5
Canarium . .	17·4	7·1	36·5	43·6	44·0

A natural series. The dipterocarpaceous resins naturally fall into a series where it is observed that the iodine value decreases with the solubility, and coincident with the decrease there is a gradual rise in the acid, ester and saponification values. **Canarium** resin, belonging to a different natural order, does not follow this rule. It is remarkable to discover in the properties of these resins the elements of a periodic law in the vegetable kingdom. It is hoped that opportunity will be afforded for following up the subject.

Elements of periodic law.

Analytical value of results. The table has, also, analytical value since it enables a sample of bazar resin of Indian origin to be referred with some restrictions to its botanical source. It has proved useful in the Indian Museum in determining samples of resin sent for identification, and in correcting those sent under a wrong name.

Pwe-nyet allied to resin. With regard to the origin and composition of pwê-nyet, the special objects kept in view in compiling the present article, it will be seen that the best quality, according to its constants, will occupy a position in the table between **Dipterocarpus** and **Hopea** resins. The constants, it will be remembered, are: Solubility 86.2, acid value 28·3, ester value 23·9, saponification value 52·2, iodine value 137·1. The composition of the exterior portions of the nest agrees in many respects with the dried resin of **Dipterocarpus tuberculatus,** in a chemically unaltered condition.

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URENA LOBATA

(FIBRE)

The use of **Urena lobata** *as a fibre material and as a possible substitute for jute. A review of existing information. By* REGINALD ABBEY-YATES.

References.—*Roxb. Fl. Ind., Ed. C.B.C., 519; Dalz. and Gibs. Bomb. Fl., 18; Royle, Fib. Pl., 263; Thwaites En. Ceyl. Pl., 25; Hooker, Fl. Br. Ind., I., 329; Ind. Kew. IV., 1149; Mason, Burma and its People, 520, 755; Drury, Useful Pl., 437; Liotard, Paper Materials, 31; Murray, Pl. and Drugs, Sind. 61; Mukharji, Catalogue, Ind. Prod., Amsterdam Exhib., 161; Watt, Catalogue Calcutta Exhib. III, No. 290; Lisboa, Useful Pl., Bomb., 228; Campbell, Catalogue Econ. Prod. Chutia Nagpur, No. 7896; Watt, Guide to Econ. and Com. Court, 206; Cross, Bevan and King, Rep. on Ind. Fib., 9, 43; Atkinson, Himalay. Dist., 306; Gazetteers:—Mysore and Coorg, I., p. 58; Bomb., XV. (Kánara), 427 XXI, (Botany), 228; N.-W. P. IV. (Agra) lxviii; Agri. Hort. Soc. Ind. Journ. (Old Ser.) IX, 405, Sel., 47; Journ. Soc. of Arts (Cantor Lectures) XLIII (1895), 407-8; Dodge, Useful Fibre Pl. of the World, 321, 322; Agric. Ledger, 1896, No. 11, p. 2; No. 37, p. 25; Haines, Forest Working Plan, Jalpaiguri, 1898, xxvii; Ann. Report, Gov. Gardens, Mysore, 1899-1900, 17; Upendranath Kanjilal, Forest Flora, School Cir., N.-W. P., 37; Ind. Forester, XXVIII (1902), 75; Cooke, Fl. Bomb., I., 100; Duthie, Fl. Upper Gangetic Plain, I, 85; Firminger, Gardening for India, 5th ed., 650; Records, Bot. Survey, Ind., III, 2, 178; Anglo-Ind. Review (1905), 34; Imperial Inst. Tech. and Sc. Rep. (1903), 108-9; Imperial Inst. Bulletin, I, (1903) xxiv, III (1905) 262, V. (1907) 9, 10, VI. (1908),134, 135; "Capital," 1903, Aug. 6, Oct. 22, Nov. 12, 1904, Jan. 14, 21, 1907, Jan. 10, 1908, Sept. 17; Ridley, Malay Pl. Names, Journ. Roy. Asiatic Soc. Straits Br., No. 30 (1907), 135, 206, 213; Agric. Bull. Straits and F. M. States, IV. (1905), 157; Tropenflanzer, IV. (1900), 562, VI. (1902), 427; L'Agricult. pratique des pays chauds, III. (1904), 692; Journal Officiel de Madagascar, No. 834 (1903), 9984; Bulletin Economique, Madagascar, IV (1904) 33, VIII. (1908) 64; Kew Bulletin, 1890, p. 198, 1891, p. 219; Additional Ser. No. II. (1898), 277, 278; Colonial Reports, Misc. No. 51 (1906) 40; Dodge, Report on Uncultivated Bast Fibres of U. S., 14; Board of Trade Journ. XXVII. (1899) 738, LXII. (1908) 91; Jornal do Commercio, Rio, reprinted in "Planting Opinion" (1899) 1905; Dipl. and Con. Rep., Annual, No. 2475 (1899) 25, No.*

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INDIA. Vernacular names.

Among the inhabitants of India the plant botanically known as **Urena lobata** is variously spoken of as—

Bun-ochra, ban okra, bun-chra, bun-kra, BENG.; *Sonborial, lakna,* ASSAM; *Lara, Seth lehra,* CHITTAGONG; *Bhidi janetet,* SANTAL; *Bachita, kukar chalni,* U. P.; *Unga,* DÚN; *Kharata,* SAHARANPUR; *Bariyari,* JEYPORE; *Villiah,* KONKAN; *Vana-bhenda,* MAR.; *Tuttinaar* (Urena sp.), TRAVANCORE; *Kat-sae-nai,* PEGU; *Wet-kyae-pa-nai,* BURM.; *Kasis-bin, Petna,* THARRAWADDY; *Kasil-me, kasihne,* YAMETHIN, *Phapy ban,* AKYAB; *Ze-nu or katse-ne,* YAUNGTHABIN, PROME.

Names of the plant in other countries.

The following are some of the names by which the plant is known out of India—

Pulut-Pulut, pepulut, MALAY; kelulut, perpulut, POKO; Toja, WEST AFRICA; Ake-iri, YORUBA LAND; Otóto grande, St. THOMÉ; Kiriza, sikilenja, MADAGASCAR; Cousine mahoe, GRENADA, TRINIDAD; Grand cousin, cousin-rouge, GUADELOUPE; Grand-mahot-cousin, MARTINIQUE; Cæsar weed, FLORIDA, U. S.; Cadillo, VENEZUELA; Aramina, Carrapicho, guaxima, uaixyma, BRAZIL.

The fibre variously spoken of in Brazil as aramina, carrapicho, guaxima, etc., is believed to be derived chiefly from **Urena lobata** and other species of **Urena.**

From experiments made at the Royal Botanic Gardens, Sibpur, Calcutta, however, with seed furnished from Brazil, it would appear that Aramina fibre is obtained in part at least from another plant which like **Urena** also occurs in India, *viz.*, **Triumfetta rhomboidea,** *Jacq.* The latter is known in the vernacular as *chikti, bun-ochra,* etc. It will be noticed that in certain localities the name bun-ochra is common to both plants. A similar case occurs in the Malay Peninsula where the two plants **Urena** and **Triumfetta** are known by the common name of *pulut pulut* (H. N. Ridley in *Agric. Bull., Straits and F. M. States,* V [1906] 199).

Introductory.

Urena lobata has of late been much discussed in various parts of the world as a possible jute substitute. The experience of those who have exploited the plant for its fibre cannot, however, be said to have been encouraging: on the other hand, such experiments on

a large scale seem to have been mainly confined to one country, *viz.*, Brazil. INDIA.

In any case, the bringing together of existing information in a convenient form for reference will, it is thought, prove useful to those interested in the subject of substitutes for jute and other fibres.

Habitat.

An erect, much-branched shrub, generally being 2 ft. to 4 ft. high with solitary, rather conspicuous pink flowers and 5-lobed nearly round fruits covered with small hooks. The stems and leaves have a white, thick, somewhat rough, hairy covering. Description of the plant.

The plant is extremely variable in size and shape of its leaves. It grows wild all over the hotter regions of India, particularly in waste areas on the edges of forest roadsides, etc. It flowers in the later part of the rains and through the cold weather. It yields a fibre which is of the jute type, but the staple is generally short, though stronger. Royle speaks of it as a tolerably fine substitute for flax. Occurrence. Fibre. Dr. Royle's opinion of it.

The following paragraphs give an account of its use as a fibre plant in India.

It is said to be known in Assam as the *lakna* or "jangli jute" of Assam. Specimens of the fibre were shown at the Calcutta Industrial Exhibition of 1906-07. Ropes are made of it in Cachar where it grows profusely and is said at times to attain 8 ft. in height on land that has been cleared of jungle and not well cultivated afterwards. In Golaghát the plant goes by the name of Sonborial, sometimes incorrectly written bon borial. There are stated to be two kinds, small and large. The fibre is by some confused with that of Rhea (**Boehmeria**) and by others with Bon Rhea (**Villebrunea**). Ropes of Sonborial (**Urena lobata**) fibre are greatly in favour with both Assamese and Bengalis. They may be met with on ticca carts; and coolies employ these ropes for carrying loads banghy-fashion to market. The fibre is considered to be very strong and durable. In Pegu, Burma, it is one of the most plentiful of weeds and it is used as a fibre plant to a small extent. Mr. L. Aubert, Superintendent of Land Records in 1906 sent to the Reporter on Economic Products through Mr. A. E. Rigg, the Deputy Commissioner, the information that in Yamethin fibre is prepared from the wild plant, and the Reporter on Economic Products in the current year found that in villages near Prome it is also prepared. In 1896 the Deputy Commissioner, Tharrawaddy, reported that it was a fibre Urena fibre finds use in Assam. In Burma.

INDIA.

plant of his district, but without distinctly stating the extent of its use.

Over the rest of India it seems that the fibre has no indigenous use.

Cultivation.

A wild plant, not cultivated.

The plant is a common weed and so far as known has not hitherto been tried in this country as a field or garden crop. Its growth is said to be rapid and to require no special care.

Preparation of the Fibre.

Fibre, how prepared in Burma.

Mr. L. Aubert, Superintendent of Land Records, describes the method pursued in the Yamethin district, Burma, thus:—"An incision is made all round the lower end of the stem of the grown up matured plant. The epidermis comes off readily, and the ligneous portion is thrown aside. Having separated the bark from the fibrous portion under it, the latter is dried in the sun for a couple of days.

When required to be made into rope the fibrous mass is soaked for a week or ten days in water. At the end of that time, it is placed on the slab and beaten with a mallet to remove all the fleshy matter. A final washing leaves the pure fibre which is placed in the sun, but not allowed to dry completely, and is twisted into rope. If too dry, it should be moistened before twisting.

An inferior kind of rope is also made with the epidermis which is not thrown away, but is used by cultivators of the poorer class for binding the yokes of their ploughs and carts."

URENA LOBATA FIBRE AS IT OCCURS OUT OF INDIA.

Urena lobata, utilisation of the fibre in other countries.

Under the common name of the Cæsar weed, it is described by Dodge in his *Descriptive Catalogue of Useful Fibre Plants of the World*, which should be consulted.

Straits Settlements.

The Straits.

From the *Agric. Bulletin of the Straits and F. M. States* IV (1905), 157, we learn that the fibre is said to be very white and a metre in length, and to take colour well. It is very strong and makes good cordage. The author concludes by stating that it does not seem that it has ever been put under cultivation, and it is doubtful if it would pay if it was.

Madagascar.

OUTSIDE INDIA: Madagascar.

Particulars regarding **Urena lobata** fibre appeared in the *Journal Officiel de Madagascar* of the 9th September 1903 and in the *Bulletin Economique, Madagascar,* IV, (1904) 33 and VIII (1908), 64. The fibre is known locally as *Kiriza* and *Sikilenja.*

West Africa.

West Africa.

The plant is known as Toja in West Africa where it finds use among the Yorubas and Haussas for making ropes and for other purposes. It is plentiful but is not cultivated. In *Colonial Reports—Misc. No. 51, Forest Administration, Southern Nigeria,* 1906, p. 40, it is stated of **Urena lobata** that it is common on waste places, round villages and recently abandoned farms. By cultivation the length of fibre can be increased. It would be interesting to know if the statement made in the sentence last quoted is the result of the writer's own experience.

United States.

United States.

The plant is common in Florida, and abounds in South America (*Dodge, Report on Bast Fibres of the U.S.,* 1894, p. 14.) By uninformed persons it is taken for ramie (**Boehmeria**).

Venezuela.

Venezuela.

Dr. Ernst, Director of the National Museum, Caracas (quoted by Dodge), describes the fibre as very fine, white in colour and a metre in length. It is very strong and takes dye readily.

Brazil.

Brazil.

As already stated **Urena lobata,** or as the plant is termed locally "guaxima," was at one time regarded as likely to prove an efficient substitute for jute. The first account of it which is recorded in the office of the Reporter on Economic Products appeared in the *Jornal do Commercio* and was subsequently given in the *Board of Trade Journal,* XXVII (1899), p. 738. It is included here to show local conditions: it must be remarked, however, that the writer was evidently not conversant with the method of preparing jute in India when he speaks of "maceration in vessels." "A correspondent of the *Jornal do Commercio* of Rio de Janeiro draws attention to the fibre of the guaxima, which grows wild everywhere, but is found in largest quantities on the low lands near the sea. It is believed that this fibre would prove an excellent substitute for jute, which

OUTSIDE INDIA. Brazil.

is all imported, and when cultivated prove the basis of an important industry.

The threads are long and very strong and will resist the action of water; the fibre being used by fishermen on the coast for their nets, which last for years if soaked in a tincture of aroeira* bark.

The process of elaboration of the guaxima fibre does not require long maceration in vessels, as is the case with jute; immersion for a few days in running water being sufficient to loosen the green outer bark with the hands, after which the rods are exposed to the sun in order to dry the woody part: this then contracts and allows the fibres to be easily separated."

In this connexion Mr. Acting Consul General Rhind writing on the Trade of Rio de Janeiro for 1899 (*Dipl. and Consular Reports, Annual Series* No. 2,475) makes this apposite remark:—It must be borne in mind that the plant [**Urena lobata**] occurs only in a wild state and in scattered quantities, so that, even should it be proved to possess the necessary qualities for industrial manipulation, there will be still the question whether it can be systematically cultivated to yield regular marketable supplies for manufacturing purposes at a cost which will allow it to compete with jute.

That the foregoing remark was fully justified in the light of subsequent events will be evident further on.

The interest aroused in the so-called new fibre received a further impetus in 1902, as will be seen from the passages quoted below which appeared in the *Tropical Agriculturist,* XXI (1902), 603:—

"According to the *Bulletin of the Bureau of American Republics,* a new fibre known as *aramina,* has recently been discovered by Dr. Silva Telles of the Polytechnic School of Sao Paulo. This fibre is obtained from a variety of plants commonly known in Brazil as carrapichos. It is almost white in colour, very fine and flexible, and is from two to three yards in length. It has been called *aramina* owing to its almost metallic lustre and wonderful flexibility. The plant from which the fibre is derived is strong and vigorous, and no special care is required in its cultivation, being perfectly adapted to uncultivated lands. It grows wild throughout the entire western part of the State of Sao Paulo and is being cultivated on a larger scale in the vicinity of Campinas.

Articles made of this fibre were recently exhibited by Dr. Telles at the Polytechnic School, Sao Paulo. These included cords, twines, ropes, and canvas suitable for coffee bags.

*Among the plants known in Brazil by this name are three spp. of ASTRONIUM, one of LITHRÆA and two of SCHINUS. All belong to the Anacardiaceæ. Schinus molle and S. terebinthifolius are probably those here referred to.

It is predicted that this discovery will revolutionise the textile industry."

OUTSIDE INDIA: Brazil.

We next find the fibre mentioned in the *Rev. des Cult. Coloniales* X, (1902) 49, under the synonym, **Urena trilobata** which with the plant **Triumfetta semitrilobata** is stated to yield the fibre called Aramina. The writer goes on to say that the plant yields 7 to 8 per cent. of fibre, while ramie gives 3 per cent.; the cultivation being cheaper; and adds it is much stronger than jute.

The new enterprise is discussed in "*Capital*," Calcutta, August 6, 1903, with regard to its possible bearing on the jute export trade of Calcutta.

That journal in its issue of the 12th November 1903 reproduces certain passages from the *Dundee Advertiser* regarding the alleged unfitness of aramina fabric for the manufacture of coffee bags. In the same place is given a somewhat unfavourable report—of too technical a nature to be reproduced here—by an expert in Dundee to whom the bag was submitted. But it is far from proved that the nameless expert was right. The expert concludes by stating that perhaps the fibre would be serviceable as a waterproof material.

The real reason why the aramina industry has not made headway is insufficient supplies of the material, or as recorded in *Diplomatic and Consular Reports No. 3283 Annual* (1903), 17-19, the neglect of sufficient systematic planting, excessive cost of production, or to the imperfections in the manufacturing process. It appears, in any case, not to be unfitness of the material for weaving purposes.

The latest recorded particulars regarding the aramina industry of Brazil are to be found in a report by H. B. M. Consul at Santos, the following extract from which is taken from the *Board of Trade Journal*, LXII (1908), 91:—

"It was thought that a substitute for jute had been discovered in the aramina plant which grows wild, but under cultivation it lost a great part of its fibrous nature, and as the supply of the wild plant was wholly insufficient, a mill, put up at a cost of some £24,000, had to be shut down, and after undergoing the necessary transformation, is now used for the manufacture of hessians." In the same connexion "*Capital*," Calcutta, 17th September 1908, may also be consulted.

Chemistry.

The earliest recorded examination of the fibre, is that mentioned in the *Report on Indian Fibres and Fibrous Substances, exhibited*

CHEMICAL COMPOSITION.

CHEMICAL COMPOSITION.

at the Colonial and Indian Exhib., 1886, by C. F. Cross, E. J. Bevan and C. M. King, 1887, p. 9.

Urena lobata.

Report by Messrs. Cross, Bevan and King.

Moisture	10·7
Ash	1·8
Hydrolysis (*a*)	11·9
Hydrolysis (*b*)	18·5
Cellulose	77·7
Mercerising	13·6
Nitration	..
Acid purification	4·0
Carbon percentage	...

Sir Daniel Morris' account of the fibre.

The next important reference to **Urena lobata** fibre will be found in the Cantor Lectures by Sir Daniel Morris, K.C.M.G., who speaks of it thus (*Journal of the Society of Arts*, XLIII [1895] 407-8):—"A very variable plant, widely distributed in the tropics. In India the easily extractable fibre is considered suitable for the manufacture of sacking and twine, and a fair substitute for flax. 'The Toja' fibre of West Africa is yielded by this plant. . . The fibre bundles are indistinguishable from characteristic *hibiscus* fibre. The filaments or cells are short, scarcely more than 1·5 to 2 mm. long."

Its examination at the Imperial Institute.

An examination of a sample of the fibre here referred to was subsequently made in the Research Department of the Imperial Institute, the results of which are given below:—

Moisture	9·9 per cent.
Ash	2·4 ,,
Loss by (*a*) Hydrolysis	12·2 ,,
Loss by (*b*) Hydrolysis	16·3 ,,
Loss by Mercerising	15·7 ,,
Loss by Acid purification	3·0 ,,
Gain by Nitration	25·8 ,,
Cellulose	73·5 ,,
Length of ultimate fibre	2·2—5 ,,

Report of Research Department, Imperial Institute, on Aramina fibre from Brazil.

In 1902 a sample of Aramina fibre was forwarded by Mr. Rhind, H. B. M. Consul-General at Rio de Janeiro, to the Imperial Institute (*Technical and Scientific Reports, Imp. Institute* [1903], 108, 109), with the following result:—"The sample sent by Mr. Rhind was almost too small for systematic examination. On this account the remarks made in this report must be regarded as provisional, a decisive opinion as to the value of the material being reserved until a larger quantity has been examined.

The specimen consisted of fine silky fibre of great length in staple, having in general the characteristics of the best jute, but

very much less lignified and of good colour. The result of its chemical examination are recorded in the following table:— CHEMICAL COMPOSITION.

Moisture	13·38 per cent.
Loss on (*a*) Hydrolysis	17·69 ,,
Loss on (*b*) Hydrolysis	17·56 ,,
Loss on Acid purification	2·5 ,,
Loss on Mercerising	19·37 ,,
Gain on Nitration	35·65 ,,
Cellulose	75·73 ,,
Length of ultimate fibre	1·5 —3·5 mm.
Length of stable	6 feet.

These results show that the fibre is of excellent quality, owing to the considerable length of staple, the high percentage of cellulose, and a small loss by acid purification. The numbers recorded show considerable resemblance to those obtained from jute of the best quality."

From *Dipl. and Cons. Report* No. 3283 Annual (1903), 17-19, we learn that a second sample of Aramina fibre was received at the Imperial Institute. The results side by side with those obtained from the examination of an Indian sample are given in the following table (*Bulletin of the Imp. Institute,* III [1905], 262):— Further examination of Aramina fibre. Professor Dunstan's Report.

——	*Urena lobata* from India.	"Aramina" fibre from Brazil.	Indian Jute, extra fine quality.
oisture per cent.	9·9	9·3	9·6
Ash, per cent.	2·4	0·7	0·7
A—Hydrolysis, loss per cent.	12·2	10·2	9·1
B—Hydrolysis ,, ,,	16·3	18·2	13·1
Acid purification ,, ,,	3·0	1·9	2·0
Cellulose, per cent.	73·5	76·0	77·7
Length of ultimate fibre	2·2—5·0 mm. or 0·09—0·2 inch.	1·5—3·5 mm. or 0·06—0·14 inch.	1·5—3·0 mm. or 0·06—0·12 inch.

Under date, 30th September 1907, Professor Wyndham R. Dunstan reported on the results of the examination of Urena fibre from India. The sample consisted of about 2 oz.—too small and not sufficiently well cleaned for chemical examination. *Description,* somewhat harsh, greyish fibre, gummy and in parts woody. *Strength,* uneven, very fair on the whole. *Length of staple,* up Report of Professor Dunstan on the Indian fibre.

CHEMICAL COMPOSITION.

to 6 feet, average about 4 feet. The report concluded with these remarks:—

"The fibre is obviously insufficiently retted as it is stiff and gummy, and the fibres have not separated properly. It resembles the sample of the "Aramina" fibre from Brazil previously examined in the Scientific and Technical Department ("See Bulletin of the Imperial Institute," Volume I, page 24,) and is, like the "Aramina" fibre, decidedly harsher than jute.

The present sample is regarded by experts as suitable for spinning and would probably be useful for mixing with jute. There is little doubt that a softer and much better product could be obtained by more careful retting. Attention should also be directed to the length of the material. The present sample is of very irregular length, some of it being of good length (about 6 feet) whilst the larger proportion was only 4 feet or less."

Gambia.

Professor Dunstan's Report on specimen from the Gambia.

A sample of **Urena lobata** fibre received from the Gambia was soft, of a greenish-grey colour, well cleaned and prepared, fine, lustrous, of good strength and about three feet long (*Bulletin, Imperial Institute*, VI [1908], 134, 135). On chemical examination it gave the following results:—Moisture 10·9, Ash 0·4, A-Hydrolysis (loss) 9·8 B-Hydrolysis (loss) 16·3, Acid purification (loss) 1·3, cellulose 74·6, per cent. In chemical composition and behaviour the fibre was superior to a specimen of "medium quality" Indian jute, with which it was compared. It was only half the usual length of jute but would nevertheless be readily saleable as a jute substitute at £17 per ton (with "medium" jute at £15 to £17 per ton). It was suggested that a consignment of the well-prepared product should be forwarded for trial sale.

Madagascar.

BREAKING STRAIN OBSERVATIONS.

The *Journal Officiel de Madagascar* dated the 9th September 1903 records the following observations:—

A thread of **Urena lobata** fibre 2 millimetres in diameter and 1 metre in length broken under a weight of 14 kilogrammes, while a thread of Italian hemp (**Cannabis sativa**) of the same dimensions broke under a weight of 40 kilogrammes.

BREAKING STRAIN OBSERVATIONS.

Strength of **Urena lobata** *compared with that of* **Abutilon Indicum** *and other fibres.*

Report on the examination of nine samples of fibre received from the Director, Land Records and Agriculture, United Provinces, on the 31st January 1906, by D. Hooper.

The samples were marked as under:—

1. URENA LOBATA (No. 25,391) Before flowering, kept in water 6 days.
2. URENA LOBATA with flowers, but before the seeds are ripe in water for 8 days.
3. URENA LOBATA seeds almost ripe. In water for 8 days.
4. URENA LOBATA Thread, roughly prepared.

No. 1.	Breaking weight	636	Fair colour, towey.
No. 2.	,, ,,	533	,, ,, ,,
No. 3.	,, ,,	383	,, ,, ,, weak.
No. 4.	,, ,,	775	coarse thread.

The figures which follow are given for purposes of comparison.

5. ABUTILON INDICUM (No. 25,392) kept in water 6 days.
6. ,, ,, (No. 25,392) ,, ,, ,, 8 days.
7. CROTALARIA JUNCEA (No. 25,393) "Sunnai."
8. HIBISCUS CANNABINUS (No. 25,394) fruits ripe.
9. CORCHORUS CAPSULARIS (No. 25,395) jute.

No. 5.	Breaking weight	342	clean white bast, weak.
No. 6.	,, ,,	372	,, ,, ,, ,,
No. 7.	,, ,,	333	towey, of little value.
No. 8.	,, ,,	546	silvery white bast, slight tow.
No. 9.	,, ,,	596	fibre slightly discoloured.

Prices and Market value.

PRICES.

Sir Daniel Morris mentions (Cantor Lectures, *Journ. Soc. Arts*, XLIII [1895] 407-8), that samples sent to Kew in 1889 were valued at £17 to £18 per ton.

Brazil.

The Acting Vice-Consul at Rio (*Dip. and Consular Rep. No. 2928 Annual* [1903], p. 11), describing the progress made in working the fibre gives the price paid in Sao Paulo for clean aramina as about 1*d.* per lb.

PRICES. Urena vs. jute.

"*Capital*" in its issue of the 14th January 1904 reviews a communication received from the same source. It is there stated that the factory at Sao Paulo was offering 200 to 300 reis per kilo (say £10 to £15 per ton) for the bark, clean, drier and ready for manipulation, and the Consul adds, there seems no desire for the business even at the higher price (Cf. *Journal d'Agricult. Tropicale*, 1904, p. 190). The local cost of Aramina material fibre in 1903 is stated by Mr. Consul Rhind (*Dip. and Cons. Report* No. 3823 *Annual* [1904], p. 19), to have been at the rate of £15 per ton for bark and £60 per ton (about) for fibre.

As regards the price likely to be realised by **Urena** fibre in London, the undermentioned valuation will be seen to be the same as that placed on the samples sent to Kew in 1889.

In 1902, a portion of the sample of **Urena lobata** fibre received from Mr. Rhind was submitted* with a statement of the results of its chemical examination to a well-known firm of fibre brokers, who reported that it could be employed for the same purposes as fine jute. Its value was estimated approximately at from £17 to £18 per ton. The brokers stated, however, that it was impossible to give the precise value of the fibre until a much larger quantity had been examined with special reference to its behaviour during spinning, weaving, and other processes to which it would be submitted. They suggested that a hundredweight or two should be sent in order that these further trials might be made.

India.

In his report on the results of the examination of **Urena** fibre from India, Professor Dunstan gives as the commercial value—£12-10*s*. to £13 per ton for spinning in admixture with jute. Medium jute was quoted at £15 to £17 per ton on the same date—30th September 1907.

A subsequent communication stated that if the fibre were more carefully retted and prepared, it would undoubtedly realise a higher price than that quoted in the report. Previous specimens of **Urena** fibre examined at the Imperial Institute have been valued at approximately the same prices as "medium" jute, which was quoted at £15 to £17 per ton when this sample of **Urena** fibre from India was valued at £12-10*s*. to £13 per ton.

The market price of **Urena** fibre would always be determined by the current value of jute; at present "medium" jute is quoted at from £14 to £16 per ton.

* by the Imperial Institute authorities.

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THE

AGRICULTURAL LEDGER

1908-09—No. 5

ORYZA SATIVA.

(THE RICE PLANT)

The Composition of Indian Rice, by DAVID HOOPER, F.C.S.

INTRODUCTORY.

The cultivation of rice is one of the most extensive of all the agricultural industries of India; the average area considerably exceeds seventy million acres annually. Its trade is one of great importance and its consumption is the largest of any food grain in the East. There are an immense variety of grains of rice differing in shape, size, weight, colour, consistence and properties. These are known under various names attributed to them on account of their supposed qualities; some are regarded as more digestible than others, some more nutritious or satisfying, while others are considered fragrant, sweet, medicinal, or useful in the arts. The finer and thinner grains usually have a higher value than the larger or coarser kinds, and the white grains are as a rule preferred for edible purposes to those that are coloured.

It appears very desirable to undertake an investigation to ascertain something more than is at present known regarding the chemical composition of the various grains. The present *Agricultural Ledger* is therefore an attempt to deal with this subject, wherein certain differences are noticed in several series of selected samples collected in various provinces for the purpose of chemical analysis. Before, however, discussing the composition of Indian rices, it will be convenient to refer to work previously done in this subject in other parts of the world.

An important paper on the "Composition of rice imported into France" was written by Mr. Balland in 1895 (*Comptes*

PREVIOUS ANALYSES.

Rendus, 121, 561—564) from which the following information is abstracted:—

Decorticated rices from the principal localities, Carolina, India, Java, Japan, Piedmont, Saigon (Cochin-China), show a percentage composition varying between the extremes quoted below:—

	Water.	Proteids.	Fat.	Amyloids.	Fibre.	Ash.
Maximum	16·00	8·82	·75	81·35	·42	·58
Minimum	10·20	5·50	·15	75·60	·18	·42

Crude rices contain a higher proportion of nitrogenous and fatty substances and ash, the limits being as follows:—

	Water.	Proteids.	Fat.	Amyloids.	Fibre.	Ash.
Maximum	13·30	9·05	2·50	75·60	2·38	2·20
Minimum	11·20	6·18	1·85	73·85	·93	1·20

No connection between size of grain and amount of nitrogen in it.

Balland found that there was no connection between the size of the grain and the proportion of nitrogenous matter, and demonstrated from his analyses that rice has more value as a food than is commonly supposed. The Cochin-China rice for instance, although the grains are small, contain as much nitrogenous matter and phosphatic ash as some wheats and rather more fat.

The following analyses are of interest:—

	Water.	Proteids.	Fat.	Amyloids.	Fibre.	Ash.
Carolina	13·10	7·10	·30	75·60	·19	·40
	15·20	8·82	·45	78·52	·28	·60
India	11·70	6·14	·15	78·60	·21	·34
	14·00	7·01	·45	80·27	·31	·44
Japan	12·30	5·50	·25	77·64	·21	·28
	15·30	6·98	·50	80·49	·36	·46
Java	12·20	6·67	·35	77·30	·24	·48
	14·80	6·86	·55	79·56	·34	·58
Piedmont	13·0	7·21	·35	75·77	·20	·40
	16·0	7·70	·45	78·21	·23	·44
Saigon	10·2	6·98	·30	76·96	·20	·28
	15·0	8·38	·70	81·35	·42	·56

Balland concludes his paper by praising rice as an article of food. It has been used from time immemorial as a basis of nour-

ishment in the East. During the expedition to Egypt the soldiers were fed almost exclusively on rice and their health suffered in no way. It transports easily, and keeps well as shown by analyses after 12 years and is therefore an advantageous food material in times of peace and war. PREVIOUS ANALYSES

With regard to the value of Cochin-China rices, a more recent study (*Revue des Cultures Coloniales*, V., 1899, 372) confirms the position given to it in the above table. Two commercial types Gocong and Baïxau were examined and the proportion of protein was found to be sensibly higher in the rice of Baïxau than in the rice of Gocong. From several analyses of each kind the following figures are given:— Cochin-China.

	Gocong.	Baïxau.
Protein in entire grain	6·48	9·00
„ „ decorticated grain . . .	7·67	10·46
„ „ the husks	1·69	2·25

The greater richness in portion of the Baïxau type explains the preference which the natives accord to it in present day diet. The grain of the first kind is equally superior in point of view of nourishment in its higher phosphoric acid content. From an agricultural point of view rice of the type Baïxau which takes from the earth greater quantities of nitrogen and phosphoric acid than Gacong rice naturally requires a land sensibly richer in these two elements, or in other words, high class rices demand rich cultivation.

With regard to the composition of Indian rices, Prof. A. H. Church (*Food Grains of India*, 1886) writes as follows:— India.

"The analyses which have been made of a large number of samples of cleaned rice, give figures which are wonderfully accordant, considering the great differences in the appearance of the specimens and the very divers conditions under which they have been grown. The fibre and adventitious earth are sometimes rather high from imperfect cleaning of the grain, but the nitrogenous constituents or albuminoids oscillate within narrow limits—probably nine samples out of ten will be found to contain not less than seven per cent. and not more than eight."

PREVIOUS ANALYSES.

India.

Here follows the composition of Indian rice which has been frequently quoted:—

Water	12·8
Albuminoids	7·3
Fat	·6
Starch	78·3
Fibre	·4
Ash	·6

In 1903 Dr. J. W. Leather recorded the analyses of eight kinds of decorticated rice (*Indian Food Grains and Fodders. The Agricultural Ledger*, No. 7 of 1903). The averages of four sorts of fine rice and four sorts of coarse rice are given below:—

	Water.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
Fine	12·25	6·45	·92	78·83	·21	1·33
Coarse	12·10	6·91	1·03	77·99	·45	1·57

In these analyses the albuminoids are somewhat low owing to the "albuminoid nitrogen," equivalent to 90 per cent. of the total nitrogen, being calculated into albuminoids, using the factor 6·25. In order to render all the figures for albuminoid or protein comparable the total nitrogen estimated by Kjeldahl's method is in the following tables calculated into this constituent.

The proteins or albuminoids of rice have recently been studied by O. Rosenheim and S. Kajuira. These chemists find 7 per cent. of total protein present in rice, of which 0·14 is a globulin, 0·04 an albumin, and the remainder a protein which like the glutenin of wheat is soluble in dilute alkali. The name oryzegenin is suggested for it.

Preparation of Rice.

WHAT IS LOST IN MILLING.

The rice is separated by various milling processes into different products which are used as food stuffs for animals. In the first place the hulls are removed by passing the grain through milling stones, screens and winnowing machines. The kernels are then decorticated, and the outer cuticle and much of the gluten layer of the grain together with the germ, constituting the rice bran or meal are removed. The final process consists in polishing the grains. For this purpose, the latter are placed in rotating cylinders of wood and wire gauze, the surface of which is covered with soft tanned hide. In the polishing process a film of gluten and

WHAT IS LOST IN MILLING.

starch cells is removed, and the fine flour thus obtained is called rice polish. The polished grains are then screened into various grades or sizes.

From experiments made by C. A. Browne of the Lousiana Experimental Station in 1904 the food value of the separated products were determined. It was found that while raw rice afforded 9·88 per cent. of proteids, the brans or rice meals gave from 9·26 to 13·41 per cent. of proteids and from 9 to 14·3 per cent. of fat. The rice polish contained from 8·5 to 11 per cent. of proteids and from 5·2 to 6·9 per cent. of fat. While the polished rice, ready for sale, contained only 6·56 per cent. of proteids. This illustrates in a conclusive manner the amount of nutritive elements removed in the preparation of rice for the market especially in the polishing process. In the tables of analyses which follow it will be seen how favourably the composition of rices simply freed from their husks compare with those where the cuticle has been removed by mechanical processes.

Effect of Cooking.

WHAT IS LOST IN COOKING.

In the preparation of rice for the table a certain amount of its nourishing properties are removed in the water in which it is boiled. A series of experiments was made with four kinds of rice in which 20 grains of analysed rice were placed in 110 c.c. of water and boiled for half an hour until properly swollen and soft. The water or *conjee* was thrown away and the boiled rices were dried and analysed. Without quoting the separate figures the average analyses are given:—

	Original rice.	Boiled rice from 100 parts of original.	Loss.
Water	12·74	3·13	..
Albuminoids . . .	6·92	6·32	·60
Fat	·25	·12	·13
Carbohydrates . .	79·13	72·86	6·27
Fibre	·34	·38	..
Ash	·62	·51	·11

RICES OF BENGAL

The boiling therefore removes more than half the fat, over 8 per cent. of albuminoids, less than 8 per cent. of carbohydrates, and 17·6 per cent. of the ash.

It should be acknowledged that the above analyses and those that follow were conducted by my assistant, Babu Surendra Nath Dey, B.A.

Bengal.

The districts of the whole of Bengal and Eastern Bengal and the province of Orissa constitute the great rice producing area of Northern India. The surplus produce of this area finds its way first to Calcutta for food for the metropolis and for foreign exportation, Behar and the Upper Provinces, and lastly to Chittagong. South of Jessor and Bákarganj in the Sunderbans is the finest rice tract of Bengal. From Jessor and Bákarganj there is a continual flow of *balam* rice westward to Calcutta.

For Orissa see page 76.

Main kinds.

The crop is divided into two main divisions—*aus* or early, and *aman* or winter rice. Another main division which however is of far less importance than the others is the *boro* or spring rice. *Aus* sown broadcast in the month of April, and is reaped during July, August and September. *Aman* is transplanted in June, July, and August and is harvested in November and December.

Boran aman is a coarser kind of rice sown broadcast in the beds of the bheels and in very low lying land in May and gathered in December and January. The *chotna aman* produces the finer kinds of rice.

Rice is prepared for the market by three methods:

Local preparation.

Balam rice consists of paddy which is husked after hot water has been sprinkled on it. The water inflates the grain and facilitates the removal of the husk when dry. *Atapa* is prepared by soaking paddy in cold water for 24 hours and then the grains are dried in the sun (hence the name *atapa* or sun prepared). When the grains are sufficiently dry they are husked in a pestle and mortar. During the process many of the grains are broken. *Atapa* with entire grains sells at a higher price than *siddha* made from the same paddy. *Siddha* rice is prepared by first soaking paddy in water then boiling it; when dry it is husked. Rice from over-boiled paddy is coarse in appearance, rice from over-soaked paddy is dark-coloured, and from over-dried paddy much broken. The proportion of rice obtained from paddy is about two-thirds by weight or one-half by cubical measurement.

The samples of Bengal rices were obtained locally. The first batch of Calcutta and Khulná rice was purchased in March 1906,

and the second batch of more northern rice was purchased in March 1907. The prices and names are attached so that it is easy to compare the chemical composition with their valuation and properties. One of the first facts to remark on is that *dadkhani*, a variety of rice considered superior to all others with a fancy price and given as an invalid diet, has the lowest amount of nitrogenous matter. The *kataribhog* of Bhágalpur is richer in nitrogen than the *kataribhog* of Dinájpur, though the grains are of the same size. The rice of lowest value, the *ghunchi* of Khulná, contains the highest amount of nitrogen, equal to 8·94 per cent. of albuminoids. Patná rice of two years old compares favourably with Patná rice of one year, not indicating any deterioration in quality in storing.

RICES O
BENGAL
Results o
analyses

Reference should be made to a form of Bengal rice called *kazla* which is much appreciated in some quarters as a more satisfying rice than that from Burma. This kind comes from Purúliá and other parts and is said to be suitable for distillation. Two samples examined in the Indian Museum afforded 8·25 and 8·75 per cent. of albuminoids, indicating a good nutrient value.

Uridhan is another special form of paddy which grows from seed left in the field during the preceding harvest. It is also called *jhara*, *balurja* and *teni* and is frequently met with in Bengal, Orissa and Assam. Two samples were analysed with the following results. No. 1 was obtained from Dacca; the grains were red and weighed 1·68 gram per centum. No. 2 was from Bardwán; the grains were red and weighed ·99 gram per centum.

	Water.	Proteids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
1 Dacca	8·70	8·37	2·73	77·50	1·10	1·55
2 Bardwan	8·60	8·06	2·20	78·71	1·08	1·35

RICES OF BENGAL.

Bengal Rices.

Registration No.	Vern. name.	Locality.	Price per maund.	Description.	Weight of 100 whole grains. in grammes.
			Rs. A. P.		
25461 .	Gulab sooroo .	Rangamatti .	5 8 0	White, fine . .	·93
25462 .	Shiti patanai .	Mundra Bazar .	7 0 0	White, coarse .	2·03
25463 .	Kamini . .	Rangamatti .	5 0 0	White, oval .	1·23
25464 .	Chhata balam .	Neragirza, Calcutta	5 8 0	Yellowish . .	1·48
25465 .	Chini shakkar .	Abdalpur . .	6 0 0	White, opaque .	1·29
25466 .	Roopsal . .	Rajahat . .	5 0 0	White, translucent	1·31
25467 .	Dadkhani . .	Haripur or Dinajpur.	15 0 0	„ „	·99
25468 .	Baik tulsi . .	Abdalpur . .	6 0 0	„ „	1·34
25469 .	Kamalbhog .	Rajahat . .	4 8 0	„ „	1·65
25470 .	Manmohini .	Fatehpur . .	6 4 0	„ „	1·23
25471 .	Sittisal . .	Rajahat . .	5 0 0	Yellowish . .	1·50
25472 .	Chhilait atab .	„ . .	6 0 0	White, opaque, broken.	1·98
25624 .	Ghunchi . .	Khulna . .	4 0 0	..	2·14
25625 .	Dudhya motal .	„ . .	5 0 0	..	2·23

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
25461 . .	11·40	7·48	·70	78·92	·60	·90
25462 . .	11·15	7·87	·40	79·46	·52	·60
25463 . .	11·45	7·48	·76	79·11	·35	·85
25464 . .	10·80	8·49	·36	79·29	·21	·85
25465 . .	11·55	6·19	·10	81·28	·43	·45
25466 . .	11·10	6·92	·16	80·52	·60	·70
25467 . .	11·15	5·74	·10	81·68	·43	·90
25468 . .	10·90	7·48	·12	80·50	·35	·65
25469 . .	10·70	7·54	·34	80·28	·49	·65
25470 . .	10·55	7·70	·20	80·76	·24	·55
25471 . .	10·90	6·24	·28	81·43	.30	·85
25472 . .	11·00	8·83	·72	78·20	·45	·80
25624 . .	11·40	8·94	·72	77·62	·57	·75
25625 . .	11·35	8·27	·66	78·43	·59	·70
Average .	11·10	7·51	·40	79·82	·44	·73

Bengal Rices—continued.

Registration No.	Vern. name.	Whence imported.	Price per maund.	Description.	Weight of 100 grains in grammes.
			Rs. A. P.		
25954	Lali bagra	Bhagalpur	5 4 0	1 year old, whitish, long.	1·69
25955	Mungi	Birampur	5 8 0	„ „ „ white, long.	1·65
25956	Chanti	Phulbari	5 0 0	„ „ „ whitish, long.	1·88
25957	Kataribhog	Bhagalpur	6 0 0	„ „ „ white, long.	1·49
25958	Chokha chanti	Gaya	5 8 0	„ „ „ white, oval.	1·93
25959	Nanhia	Dinajpur	5 10 0	„ „ „ white, long.	1·61
25960	Kataribhog	„	6 0 0	„ „ „ white, long, rather fine.	1·44
26074	Nagra	Bardwan	6 0 0	Atap, white, long, rather coarse.	1·83
26075	„	„	5 8 0	Steamed, translucent.	1·72
26206	Patna table rice	Calcutta market	..	1 year old	..
26207	Old Lard Patna rice.	„ „	..	2 years old	..
26208	Patna table rice.	„ „	..	1 year old, broken rice.	..

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
25954	12·35	8·27	·36	77·16	·76	1·10
25955	12·40	6·13	·28	79·86	·68	·65
25956	12·20	6·69	·60	78·64	·67	1·20
25957	12·40	7·31	·20	78·96	·38	·75
25958	12·95	6·92	·18	78·93	·27	·75
25959	12·85	6·52	·24	78·93	·46	1·00
25960	12·65	6·58	·32	79·14	·46	·85
26074	11·80	7·87	·38	79·02	·38	·55
26075	11·30	7·48	1·22	78·08	·82	1·10
26206	12·70	6·69	·26	79·37	·48	·50
26207	12·40	7·59	·24	79·02	·20	·55
26208	12·40	7·08	·52	79·16	·24	·60
Average	12·37	7·09	·40	78·86	·48	·80

Eastern Bengal and Assam.

RICES OF EASTERN BENGAL AND ASSAM.

The staple crop of the province is grown under three names representing three seasons.

Main kinds.

Aus or early summer rice is sown broadcast in March, April or May and is reaped in July or August. Summer rice is grown either in high land, or in low land near the Brahmaputra; its cultivation closely resembles the *jhum* cultivation of the hill tribes.

Aman or late rice is sown in marshy tracts in March, April or May and is reaped in November and December.

Sali or *sail* is transplanted winter paddy. It is planted in nurseries in May and June, transplanted in July, August and September, and harvested in December and January.

Aman is a long stemmed class of paddy which yields a smaller outturn than *sail* while the grain is not as a rule so fine.

The samples of Eastern Bengal and Assam rices were received towards the end of the year 1906 and the beginning of 1907. Most of them were white rices, and illustrative of the different crops; and they had been prepared either as *atap* or sun dried, or steamed. Those numbered 26649 to 26767 were exhibited at the Agricultural and Industrial Exhibition at Calcutta in 1906. *Kumbhi* and *fooren* were two of the best kinds from Manipur. *Boka-chal* is a peculiar variety that does not require boiling, but only steeping in hot water to render it edible. It is used by the Assamese like *cheerah*. *Kalojira* is one of the best kinds of *sail* rice, a reputation supported by its analysis. These are all good rices as far as their composition goes, no less than eight samples yielding over 8 per cent. of proteids.

Analyses.

Eastern Bengal and Assam Rices.

Registration No.	Date of receipt in office.	Vern. name.	Locality.	Price per maund.	Description.	Weight of 100 grains in grammes
				Rs. A. P.		
26049 .	12th September 1906.	Kalojira . .	Mymensingh.	10 0 0	White, long, medium atap, cultivated.	1·16
26052 .	„ „	Bank tulsi .	„ . .	9 8 0	White, translucent, long, rather fine. steamed, imported.	1·33
26053 .	„ „	Aus chal or Bitri chal.	Dhubri . .	6 0 0	Red, oval, coarse, steamed, cultivated.	1·77
26058 .	„ „	Aus . .	Chandpur .	7 0 0	White, long, rather coarse, steamed, imported.	1·71
26059 .	„ „	Aman . .	„ .	7 0 0	Dull red, long, coarse, steamed, imported.	1·83

Eastern Bengal and Assam Rices—contd.

Registration No.	Date of receipt in office.	Vern. name.	Locality.	Price per maund.	Description.	Weight of 100 grains in grammes
				Rs. A. P.		
26061 .	12th September 1906.	Bardhana .	Goalpara	7 0 0	Reddish, oval, rather coarse, steamed.	1·69
26063 .	„ „	Patidhan .	„ .	5 0 0	White, slightly translucent, long medium, atap.	1·65
26406 .	29th January 1907.	Sonamukhi .	Chittagong .	..	White, translucent, oval, fine, atap, scented.	·88
26407 .	„ „	Baytee (Desi) .	„ .	..	White, long, medium, atap.	1·54
26649 .	14th March 1907	Rajimani .	Fultalla, Bogra	..	White, translucent, long, rather fine.	1·12
26687 .	„ „	Boka or komal	Tezpur .	..	Whitish, long, coarse.	1·80
26689 .	„ „	Bara dhan .	„ .	..	White, oval, medium.	1·75
26690 .	„ „	Maniki madhuri or Kunkunia jaha.	„ .	..	White, oval, fine .	·83
26749 .	„ „	Fooren . .	Manipur .	..	White, long, coarse	1·84
26754 .	„ „	Kumbi . .	„ .	..	White, long, coarse.	1·93
26767 .	„ „	Kataribhog .	Nacgaon, Rajshahi.	..	White, long, fine .	·98

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
26049 . .	10·60	8·32	·28	79·48	·62	·70
26052 . .	10·55	8·21	·10	80·22	·42	·50
26053 . .	10·05	7·99	·36	79·78	·82	1·00
26058 . .	10·35	8·21	·48	79·40	·76	·80
26059 . .	11·00	6·80	·16	80·03	·76	1·25
26061 . .	10·55	8·15	·46	79·11	·78	·95
26063 . .	12·20	7·48	·66	78·42	·64	·60
26406 . .	10·85	8·49	·94	78·38	·44	·90
26407 . .	11·00	6·35	·84	80·56	·50	·75
26649 . .	11·10	6·64	·58	80·16	·72	·80
26687 . .	12·20	7·03	·86	77·66	·80	1·45
26689 . .	12·15	8·49	·62	77·35	·54	·85
26690 . .	11·85	8·10	·78	78·03	·44	·80
26749 . .	11·30	8·32	·68	78·53	·42	·75
26754 . .	11·85	7·59	·48	79·08	·40	·60
26767 . .	11·50	6·52	·22	81·11	·20	·45
Average .	11·19	7·67	·53	79·21	·58	·82

Burma.

RICES OF BURMA. ain kinds.

Burma is considered the main rice-producing province of the East. The cultivation of rice has long been the most important item in the agriculture of this country. For the year 1906-07, for instance, the exports of cargo rice from Rangoon amounted to no less than $2\frac{1}{4}$ million tons.

The crop is divided into three main classes: *Kauk-gyi*, *kauk-yin* and *mayin*. *Kauk-gyi* is the late rain paddy. It is sown in nurseries in June or July, transplanted in August, and reaped in December or January. It thus occupies the land for about eight months of the year, and in most places is the principal and most valuable crop. *Kauk-yin* is the early rain paddy, sown in April and reaped in July or August. It is grown in the lowest lands which are soonest flooded; it is a quick-growing rice. *Mayin* is dry weather paddy, grown on lands from which floods are subsiding. It is sown in December or January and reaped in May.

There are a large variety of rices in Burma as in other provinces, but the most important one and that which forms the staple of the export trade is the *kauk-gyi*, "or great paddy" so called on account of its great superiority to other kinds. *Nga-sein*, one of the races of this crop, gives a hard-grained, heavy rice capable of taking a fine polish that fits it for sale in the European markets. Glutinous rice obtained from *kauk-nyin* paddy is used in small quantities in almost every household, and many cultivators grow a field or two for home consumption. Many of the *kauk-nyin* paddies are markedly coloured; some are yellow while others are red or dark purple. *Kauk-nyin* is so glutinous that it will not stand the boiling required by ordinary rice, but is made into various kinds of puddings and sweetmeats. It is supposed to be the medium for agglutinating cakes of brick tea. It is frequently boiled in bamboo tubes to be eaten cold by travellers. When required, the bamboo is peeled off and a long roll of glutinous looking rice appears which forms a palatable substitute for bread. It is said to be very sustaining.

Nacranzie (*Nakenjee*) is the chief staple of Akyab and sells for Rs. 2 or Rs. 3 more per hundred baskets (a basket equals 1 bushel) than the other kinds in the district.

The Burmese rices show a good average composition, the best sample chemically considered being the red rice grown by the Chins in hill cleanings, where a rich virgin soil is made available.

The glutinous rice does not differ much in its composition from the ordinary rices of this Province. Dr. Greshoff, of Haarlem,

RICES OF BURMA.

obtained 7·69 and 7·56 per cent. of albuminoids in two samples from Java, results which agree with mine in showing that the glutinosity is not dependent on the nitrogenous ingredients but probably on the carbohydrates.

In connection with the sample of black rice called *ambon* yielding 7·82 per cent. of albuminoids, it is of interest to recall the analysis of a sample of black rice of Burma made by Prof. A. H. Church when 9·2 per cent. of albuminoids was obtained.

Analyses.

Burmese Rices.

Registration No.	Vern. name.	Locality.	Price per maund.	Description.	Weight of 100 grains in grammes.
			Rs. A. P.		
21760 .	Nga-sein . .	Pegu . . .	..	Red, roundish .	1·97
21761 .	Kauk-nyin . .	„ . . .	..	Whitish, glutinous	2·22
25626 .	Rangooni chal .	Rangoon . .	5 0 0	..	2·13
26062 .	Bardhana . .	„ . .	6 8 0	White, oval .	2·19
26384 .	Ambon . .	Kyauktaw, Akyab district.	..	Black, long, unsteamed.	2·17
26387 .	Nakenjee . .	„ „	..	White, oval, unsteamed.	2·30
26389 .	Khayan chain .	„ „	..	White, long, unteamed.	2·07
26398 .	Horuchikan (new)	Buthidaung, Akyab district.	..	Translucent, oval, fine.	1·27
26408* .	..	Krin-Chaung, Northern Arakan.	..	Red, long .	1·66
31310 .	..	Rangoon . .	..	White, long, glutinous.	1·86

* Red rice grown on *taungyas* or hill clearings by the Chins.

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
21760 . .	12·20	6·92	·24	79·36	·53	·75
21761 . .	12·35	8·10	·42	78·05	·23	·85
25626 . .	11·30	7·48	·62	79·56	·34	·70
26062 . .	11·35	7·54	·50	79·67	·44	·50
26384 . .	12·05	7·82	2·54	75·09	1·10	1·40
26387 . .	12·10	6·97	1·32	78·21	·60	·80
26389 . .	11·30	7·20	·96	79·69	·40	·45
26398 . .	10·95	7·37	1·14	79·10	·74	·70
26408 . .	10·85	8·32	1·60	77·34	·94	·95
31310 . .	11·00	7·68	·44	79·79	·44	·65
Average .	11·54	7·54	·98	78·59	·58	·77

Cuttack.

RICES OF ORISSA.

The rices of this district of Bengal are considered separately owing to the abundant rainfall, the extensive system of irrigation and the peculiarity of the soil which although not particularly fertile renders it specially suited to this crop. Rice is grown over 97 per cent. of the cultivated area of Cuttack. The varieties are very numerous, but they all fall under one of three heads according to the season at which they are sown and reaped. 1. *Biali* or early rice is sown in high moist lands in May or June, and reaped in August and September. The chief varieties are *sathika*, *kulia* and *aswina*. 2. *Sarad*, or winter rice is sown in middling high lands in June and July and harvested between October and January. The following are the most important varieties: *Khaiara*, *kalasin*, *bankoi*, *matara*, *rungiasina*, *nripatibhog*, *gopalbhog*, *bansbati*, *bandiri* and *naisinbhog*. 3. *Dalua*, or spring rice is sown in low wet lands after the floods have subsided and is harvested in March and April. Its chief varieties are *pia* and *kasunda*.

Main kinds.

The most important of all these crops is *sarad dhan* or winter paddy corresponding to *aman* paddy of Bengal. It is divided according to the amount of water it requires into *guru* or heavy and *laghu* or light varieties.

The following samples were collected by the Reporter on Economic Products while on tour in Cuttack in August 1906, and were analysed in February 1908.

The average albuminoid content of these rices is low. The two highest priced samples are also high in albuminoids, but with regard to the others there is no connection between the value and composition. The preparing of the grain by sun drying or steaming does not appear to influence the composition.

Analyses.

Cuttack Rices.

Registration No.	Vern. name.	Price per maund.	Description.	Weight of 100 grains in grammes.
		Rs. A. P.		
25975	Handa	6 8 0	Sarad, steamed, reddish, oblong, opaque.	1·58
25976	Lajuk badan	6 10 9	Atap sarad, white, long, fine	0·93
25978	„ „	6 10 9	Sarad, steamed, whitish, oblong, fine	0·79
25979	Mach kanta	6 10 9	Atap sarad, white, long, coarse	1·26
25981	Geri	6 10 9	Sarad, steamed, whitish, oval, coarse	1·39
25983	Basu mati	6 12 0	Atap sarad, white, long	0·83
25985	Mach kanta	6 10 9	Sarad, steamed, whitish, long	1·25
25986	Kapur kanta	7 0 0	Sarad, steamed, white, long, fine	0·82
25987	Rice for mudi	7 8 0	Sarad, steamed, whitish, long	1·66
25989	Motsafa	6 8 0	Sarad, steamed, reddish, oval, coarse	1·82
25993	Nal Tukri	6 8 0	Sarad, steamed, reddish, oval	1·31

RICES OF ORISSA.
Analyses.

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
25975 . .	11·15	6·69	·30	80·32	·34	1·20
25976 . .	11·65	5·81	·28	81·48	·18	·60
25978 . .	11·45	7·56	·22	79·47	·30	1·00
25979 . .	10·95	5·62	·48	81·65	·30	1·00
25981 . .	10·70	6·19	·34	81·33	·34	1·10
25983 . .	11·35	7·19	·34	79·84	·38	·90
25985 . .	10·85	6·69	·40	80·41	·50	1·15
25986 . .	9·40	7·37	·32	81·11	·50	1·30
25987 . .	11·10	7·19	·20	80·35	·26	·90
25989 . .	10·95	5·44	·22	82·73	·36	1·00
25993 . .	11·25	6·69	·22	80·28	·36	1·20
Average .	10·92	6·58	·31	80·81	·35	1·03

Central Provinces.

RICES OF THE CENTRAL PROVINCES.

Rice is the most important crop in the Province covering about 7,000 square miles in 1903-04 or 24 per cent. of the cropped area. The rice lands are situated in the eastern portion in the Wainganga and Mahánadí basins including the south of Bálághát, Bhandára, and Chándá, and the three Chhattísgarh districts. All these lands consist of yellow, sandy soil formed from metamorphic or crystalline rock. Rice is sown as soon as the rains have well broken or towards the end of June, and the harvest lasts from the middle of September to the middle of December according to the different varieties and the different soils. Rice is grown year after year without rotation, and manure is necessary to keep up the productive capacity of the fields. Besides the rice consumed in and exported from the Central Provinces, the imports principally from Burma constitute about one-sixth of the total imports of grain and pulse.

Samples were received from Ráipur in January 1908 and analysed in February. Among the varieties sent *hansa* is classed as good, *chilakat* middling, and *kubri mohar* inferior. The amount of albuminoids in these kinds is however uniform. The finer varieties, *chini kapur* and *luxmibhog*, contain the largest amount of nitrogen.

RICES OF THE CENTRAL PROVINCES.

Analyses.

Rices from Central Provinces.

Registration No.	Vern. name.	Locality.	Description.	Weight of 100 grains in grammes.
28084	Kubri mohar	Raipur	Whitish, long, medium	1·15
28085	Chila kat	„	Whitish, long, coarse	1·74
28086	Gurmatia	„	White, oblong, coarse	1·81
28087	Bhejri	„	Whitish, long, coarse	1·69
28088	Hansa	„	Whitish, long, medium	1·61
28089	Chini kapur	„	Whitish, round, fine	0·80
28090	Laxmi bhog	„	White, round, fine	0·86

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
28084	9·05	6·25	·90	82·35	·40	1·05
28085	9·15	6·25	·70	82·73	·42	·75
28086	9·65	7·25	·84	80·87	·54	·85
28087	9·55	6·19	·88	82·08	·40	·90
28088	9·00	6·25	·84	82·60	·36	·95
28089	8·45	7·31	1·32	81·38	·44	1·10
28090	8·50	7·25	·64	82·36	·40	·85
Average	9·05	6·68	·88	82·05	·42	·92

United Provinces.

RICES OF THE UNITED PROVINCES.

The rice crops in these provinces are of two kinds:—Early rice or *dhan*, called *kuanri*, *bhadan* or *kartiki*. This is sown broadcast in July and harvested in September and the early part of October. Late or transplanted rice commonly called *jarhan*. This is planted in heavy clay lands, in the neighbourhood of jhils or wherever water is available and is harvested in November and December. This is of better quality and quantity than the former. Rice is produced in the largest quantities in the belt of low lying land that fringes the Himálayas, and the cultivation increases as one goes eastward. Rice of Tulsipur in Gonda is said to be the finest produced in India and is celebrated as one of the sources of "Patná" rice, named after the town whence it is distributed. The exports of these provinces however do not exceed the imports. The latter come almost entirely from Calcutta, and the former go principally to the Punjáb and Rájputána.

RICES OF THE UNITED PROVINCES.

The samples of rice paddy from the United Provinces were received in February 1909 and were cleaned in the laboratory by simply removing the husk. They have a good composition high in proteids and fat. The *jalera* or red varieties are similar to the white varieties. The finest grains are found in the *jarhan* crop and the coarsest in the *kuanri*, but the latter are somewhat superior as a whole in the amount of proteids they contain.

Analyses.

Rices from United Provinces.

Registration No.	Vern. name.	Locality.	Name according to season.	Description.	Weight of 100 grains in grammes.
30646 .	Harkeswa . .	Faizabad District	Kuanri . .	Red, oblong, medium	1·54
30648 .	Sufedká . .	„ „ .	Jarhan . .	White, translucent, long.	1·49
30649 .	Lalka or Rambhog	„ „ .	Jarhan . .	Red, oblong, medium	1·64
30651 .	Karangi . .	Benares . .	Kuanri . .	Red, oblong, coarse .	2·07
30655 .	Shamzira . .	„ . .	Jarhan . .	White, translucent, long.	1·47
30657 .	Lajura or Jillaur	„ . .	Jarhan . .	Red, long, medium .	1·77
30653 .	Lalbagri . .	Rai Bareli .	Kuanri . .	White, transulcent, oblong.	1·54
30661 .	Dehula . .	„ „ . .	Kuanri . .	Red, oblong . .	1·62
30664 .	Gondawa . .	„ „ . .	Jarhan . .	Light red, long .	1·71
30665 .	Badarphui or Badshapasand.	„ „ . .	Jarhan . .	White, translucent fine.	·88

Kuanri reaped in Aswin and jarhan in Aghran.

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
30646 . .	10·00	7·59	2·84	76·97	1·04	1·65
30648 . .	10·9	6·81	2·74	76·96	·94	1·60
30649 . .	10 65	7·12	2·92	76·81	1·00	1·50
30651 . .	10·20	7·00	2·94	77·34	1·02	1·50
30655 . .	8·95	7·62	·68	78·22	·88	1·65
30657 . .	10·65	7·50	·96	76·32	1·02	1·55
30658 . .	9·00	8·62	76	76·83	1·14	1·65
30661 . .	9·95	7·62	2·54	77·51	1·08	1·30
30664 . .	9·80	7·12	2·78	77·75	1·00	1·55
30665 . .	10·20	7·44	3·18	76·64	·94	1·60
Average .	10·03	7·44	2·83	77·14	1·00	1·56

Nepál.

RICES OF NEPAL.

Rice is the most common crop in Nepál. In the greater valley (Nepál proper) with Khátmándu, the capital, and situated 4,700 feet above the level of the sea, two crops are grown per annum; these are the transplanted and the untransplanted or *gyah* rice. The former is sown in May, is transplanted as soon as the rains have fairly set in, *i.e.*, early in July, and is reaped in November.

Main kinds.

The *gyah* rice is sown in the higher level lands during the latter half of April, and is ready for cutting by the end of August or beginning of September. In the Biasis or low lying lands near the rivers, only one crop is grown, namely, transplanted rice. These Biasis are chiefly tongues of Terai land which extend along the lower river courses into the hills. That only one crop should be grown is due to the excess of moisture, and want of drainage and the total absence of artificial irrigation, and there are no means of drying the fields rapidly enough for a spring crop. The rices grown in the low lands about Nayakot are different from those grown in the greater valley with the exception of *malsi* and *touli*. *Manseri* is the staple crop of Nayakot, and is of several kinds as *doodia, gouria,* etc. It is of a brighter golden hue, longer in the stalk than other rices and is equal to the best in quality. Among the twenty sorts grown at Nayakot are *malbhog, krishenbhog* and other fine descriptions for which Pilibhít is so famous. None of these can be raised in the greater valley of Khátmándu.

Large quantities of rice are exported from Nepál into British India—chiefly of those grown in the Terai. Samples from the frontier station of Raxaul and at Khátmándu were collected by Mr. Burkill during a tour made at the end of 1907.

In the Khátmándu rices there is a remarkable uniformity between the market value and the chemical composition. The *samudrafin* at Rs. 10-10 has the highest nitrogen value, while those priced at Rs. 9-6 per maund (82·3 lb.) are somewhat less. The only exception is in the *hakua* sample which has the lowest commercial value combined with a high protein yield. It is to be noticed that there is no deterioration chemically in those rices of one and two years' storage compared with the recent crop.

RICES OF NEPAL.

Analyses

Nepal Rices.

Registration No.	Vern. name.	Locality.	Price per maund.	Description.	Weight of 100 grains in grammes.
			Rs. A. P.		
28029 .	Dudhi saru . .	Raxaul, Champaran	4 4 0	Reddish, long, crop of 1907.	1·39
28030 .	Basful . .	„ „ .	5 0 0	White, long, 1 year old.	1·69
28031 .	Balessari . .	„ „ .	6 0 0	White, long, 2 years old.	1·32
28035	Rato marsi . .	Khatmandu . .	6 14 0	White, oval, rather coarse, crop of 1907.	1·83
28036 .	Samjira . .	„ . .	9 6 0	White, long, crop of 1907.	1·38
28037 .	Basmati . .	„ . .	9 6 0	White, long, crop of 1907.	1·33
28038 .	Gouria . .	„ . .	9 6 0	Whitish, long, 1 year old.	1·16
28039 .	Samudrafin . .	„ . .	10 0 0	White, long, 1 year old.	1·22
28041 .	Jara Marsi . .	„ . .	6 14 0	White, oval, crop of 1907.	1·75
28044 .	Touli . . .	„ . .	8 12 0	Whitish, oblong, crop of 1907.	1·76
28046 .	Krishenbhog .	„ . .	7 8 0	White, oblong, 2 years old.	1·27
28047 .	Chaba . . .	„ . .	7 8 0	White, long, 1 year old.	1·27
28048 .	Hakua . .	„ . .	5 10 0	Light brown, translucent, oblong, crop of 1907.	1·58

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
28029 . .	10·40	7·75	1·14	78·28	·58	1·85
28030 . .	10·90	6·75	·68	80·54	·28	·85
28031 . .	11·05	6·81	·50	80·67	·22	·75
28035 . .	11·10	6·81	1·02	79·94	·28	·85
28036 . .	11·60	7·75	·88	78·59	·28	·90
28037 . .	11·35	7·31	·62	79·85	·22	·65
28038 . .	11·85	7·31	·68	79·08	·28	·80
28039 . .	11·35	8·81	·56	78·34	·24	·70
28041 . .	11·55	6·63	·90	79·81	·26	·
28044 . .	11·75	7·81	·84	78·52	·28	·
28046 . .	11·50	7·87	·56	79·13	·24	·70
28047 . .	11·25	7·31	·74	79·66	·34	·70
28048 . .	10·95	8·56	1·88	76·32	·74	1·55
Average .	11·28	7·50	·85	79·13	·32	·92

Punjáb.

RICES OF THE PUNJAB.

Rice is grown chiefly in Kángra, Hoshiárpur, Karnál and Ambála districts, and throughout the Lahore and Múltan divisions. It ordinarily covers 1,100 square miles. Wherever there are low lands which are inundated either by natural or artificial means rice is produced. As in other provinces it is one of those crops that requires raising first in a nursery after which the seedlings are planted out. The sowings extend from March to August, and the crop is harvested in September and October.

The upper valleys of Kángra are the granaries of rice, where abundance of water, high temperature and peculiar soil are favourable. Here the small fields of rice descend in successive terraces levelled and embanked; in the west of Dera and Núrpur where the country is less broken the fields are larger in size and the red soil and green hedges are suggestive of a Devonshire landscape. In many parts of these districts wide areas bear a double harvest.

Main kinds.

The samples of Punjáb rice were purchased by the Reporter on Economic Products in Simla in 1906. They represent the varieties grown in the hilly districts of Sirmur, Kángra, Suket, Biláspur, etc., and are priced according to the values put upon them in the Simla market. *Bansmati* (the fragrant) and *sukhdas* are the most esteemed kinds; they are white fine table rices. *Ramjamani* has a hard fine grain; it is a variety of *ziri* and is grown in some places as a luxury. *Jhinjhin* and *hansraj* are coarser kinds of lower quality. *Kharsu* is a very coarse Punjábi rice which is only grown on poor soils. The coarse rices form the staple food of the villagers and cultivators, and the best rices are those exported. It seems that the vernacular names used to indicate the quality are not always to be depended upon. For instance, that known as *begami* (queen's rice) grown in Simla is not so good as what is known by that name in Kángra.

In the analyses of these rices the finer or smaller kinds are on the whole richer in nitrogen than the coarser and larger kinds; but there is no uniformity of composition in those samples taken from the same district, nor is there any relation between the composition and the market value.

RICES OF THE PUNJAB. Analyses.

Punjáb Rices.

Registration No.	Vern. name.	Locality.	Price per maund. Rs.	A.	P.	Description.	Weight of 100 grains in grammes.
25743 .	Bogra . .	Sirmur . .	5	0	0	Red, oval, very coarse.	3·02
25744 .	Tira . . .	Kangra . .	4	8	0	White, long, medium	1·78
25745 .	Hansraj . .	Suket .	6	0	0	„ „ „	2·42
25746 .	Bansmati . .	....	7	0	0	„ „ „	1·53
25747 .	Kasiatu . .	Arki and Bilaspur	5	0	0	Red, oval, coarse	1·92
25748 .	Ujla . . .	Sirmur . .	5	4	0	White, oval, coarse	2·73
25749 .	Kalan . .	„ . .	5	12	0	„ „ „	2·69
25750 .	Rhiand . .	Suket . .	6	0	0	White, long, medium	1·84
25751 .	Rhinjri . .	Andur, Bilaspur .	6	4	0	„ „ „	2·06
25752 .	Jhinjhin . .	Suket . .	5	8	0	White, oval, medium	2·11
25753 .	Sukhdas . .	Palampur . .	8	0	0	White, long, medium	1·72
25754 .	Basumati . .	Amritsar . .	8	4	0	„ „ „	1·77
25755 .	Sirmaoribegmi .	Sirmur . .	5	8	0	White, long, coarse	2·43
25756 .	Ramjamani .	....	5	5	3	White, long, rather fine.	1·32

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
25743 . .	12·90	6·58	·40	78·78	·44	·90
25744 . .	12·65	6·69	·38	78·85	·53	·90
25745 . .	12·60	6·24	·42	79·64	·40	·70
25746 . .	13·20	7·70	·18	77·95	·22	·75
25747 . .	11·65	6·92	·60	79·18	·80	·85
25748 . .	12·90	6·97	·60	78·18	·50	·85
25749 . .	12·30	7·37	·30	79·11	·22	·70
25750 . .	12·90	8·10	·30	77·52	·48	·70
25751 . .	13·00	7·14	·22	78·62	·32	·70
25752 . .	13·40	6·24	·62	78·64	·40	·70
25753 . .	12·50	7·14	·20	79·05	·46	·65
25754 . .	13·20	6·81	·18	78·99	·22	·60
25755 . .	13·60	6·47	·42	78·13	·63	·75
25756 . .	13·65	7·31	·26	77·64	·34	·80
Average .	12·89	6·98	·36	78·63	·39	·75

RICES OF BOMBAY.

Bombay.

In Western India rice is chiefly a *kharif* crop dependent upon the monsoon rains. In the south of the Presidency *rabi* rice which ripens in the hot weather is grown. The chief rice areas are near the Western Ghâts in the belt of low land which lies between these hills and the sea. In the northern taluks of Surat, in Broach and Gujarát where the rainfall is lighter rice beds occupy positions near tanks or other sources of irrigation.

It is generally accepted that the early ripening rices produce the coarser grains, and the late ripening crop, requiring plenty of water, yield the finer kinds. The first are generally sown broadcast or by drills in poor fields in June and reaped in September.

Main kinds.

Examples of these rices are *chinian sal, dodke, kolambe, kothinbare* and *varangal*. The second are sown late in May in manured seed beds, planted into wet fields in July, August, and reaped late in October. Examples are *kamode, ambemohar, kale raybag,* and *rajaval*. *Ambemohar* is white, opaque, soft and fragrant and commands a high market rate. In Broach three varieties are grown: a fine kind *sukhvel,* raised under tanks in villages; *sutarsal,* a rice of medium quality most generally eaten; and *dudni,* a coarse rice, drilled in dry cropped land. Only the first variety is transplanted from nurseries.

Samples of Bombay rices from Sind, Surat and Dhúliá were received by the Reporter on Economic Products in April 1908, and further samples from the Karnátic, Belgáum and Dhárwár were received in September 1908. The samples were all received in the form of paddy, the husk only of which was removed before analysis. This will explain the presence of the uniformly high amounts of oil and albuminoids in the selected samples. In the Surat samples *bengalia* rice which sells for Re. 1 per Surat maund (=28 lb.) is much superior to *kada,* an early rice, which sells for 12 annas per maund. This difference is borne out by comparing the composition where *bengali* contained 9 per cent. of all albuminoids. *Dhundani* from Broach also has a high nutrient value. *Kamod* from Dhúliá which has the best reputation of all the North Deccan rices possesses a high nitrogen content. Among the Karnátic rices the sample called *ambersal* from Khánapur has the best composition probably due to the excellent form of manuring known as *rabi* practised in the district.

RICES OF BOMBAY.
Analyses.

Bombay Rices (Sind, Surat and Dhulia).

Registration No.	Vern. name.	Locality.	Description.	Weight of 100 grains in grammes.
28447	Matian (*viz.*, pearly)	Lower Sind	Red, oblong, coarse	2·61
28448	Gunga	Do	Red, oblong, coarse	2·72
28449	Ratria (*i.e.*, inclined to red).	Do.	White, long, coarse (rather medium).	1·67
28450	....	Grown in the Nara valleys of the Thar and Parkar District, Sind.	White, long, coarse	2·01
28860	Bengalia	Chikli, Surat	Whitish, translucent, oblong, medium.	1·14
28861	Dhundhani	Broach	Whitish, oval, coarse	1·82
28862	Kolam	Chikli, Surat	Whitish, translucent, long, fine	·07
28863	Sukhvel	Broach	Whitish, translucent, long, medium.	1·77
28864	Kada	Olpad, Surat	Whitish, translucent, oblong, coarse.	1·82
28865	Bhusalia	Chikli, do.	Whitish, long, medium	1·56
28866	Kada	Chikli, do.	Whitish, oblong, coarse	1·82
28867	Monghi Salia	Bardoli, do.	Pinkish, oblong, coarse	2·05
29121	Jadi Sal	Dhulia	Red, oblong, coarse	2·22
29122	Dodka Sal	Do.	Whitish, translucent, long, medium.	1·71
29123	Dhana Sal	Do.	Red, oblong, coarse	1·86
29337	Kamod	Do.	Whitish, translucent, long, medium.	1·24

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
28447	10·25	7·31	2·44	76·77	1·08	2·15
28448	10·20	7·00	1·96	78·03	1·06	1·75
28449*	10·20	7·62	2·70	76·82	1·06	1·60
28450	10·10	6·50	2·96	77·83	1·26	1·35
28860	14·15	9·00	2·96	71·37	·92	1·60
28861	13·60	9·81	2·90	71·12	·92	1·65
28862	13·70	7·87	2·70	73·62	·76	1·35
28863	13·90	6·75	2·70	74·56	·94	1·15
28864	13·70	6·81	2·50	74·62	·92	1·45
28865	13·30	8·18	2·90	73·43	·74	1·45
28866	13·60	7·50	2·60	74·15	·80	1·35
28867	12·95	7·87	2·48	74·71	·74	1·25
29121	12·75	7·06	2·40	75·28	·76	1·75
29122	12·60	6·75	2·74	75·72	·74	1·45
29123	12·60	7·31	2·40	75·48	·76	1·45
29337	14·15	9·75	3·06	70·54	·80	1·70
Average	12·61	7·69	2·65	74·63	·89	1·53

* Only white rice taken for analysis, the red grains being rejected.

RICES OF BOMBAY.

Analyses.

Bombay Rices (Karnatic).

Registration No.	Vern. name.	Locality.	Description.	Weight of 100 grains in grammes.
29412 .	Sali bhatta .	Sampgaon . .	Whitish, oblong, coarse, translucent.	2·38
29416 .	Dodagen kirsali bhatta.	Do. . .	White, oval, coarse . . .	2·26
29417 .	Kare ambemohar	Do. . .	Whitish, oblong, fine, translucent.	1·02
29419 .	Sanna bhatta kirsali.	Do. . .	Whitish, oblong, medium .	1·87
29421 .	Kala jirga . .	Chandagad .	Whitish and greenish, long, medium.	1·25
29429 .	Ambersal (small)	Khanapur . .	Whitish, long, medium, translucent.	1·43
29432 .	Madhali atsal .	Belgaum . .	Whitish, oblong, coarse . .	2·59
29444 .	Ambemohar (white)	Do. . .	Whitish, long, fine, translucent.	1·07
29447 .	Sadharam pandhara.	Chikodi . .	Whitish, mixed with red, oblong, coarse.	1·92
29449 .	Halga . .	Kanara . .	Red, oblong, coarse, starchy .	2·75
29451 .	Dodaga . .	Chandagad .	Whitish with red, oblong, coarse	2·15
29453 .	Hukeri rice No. 1.	Hukeri . .	Whitish with red, oblong, coarse	2·55
29458 .	Burmalgi . .	Kanara . .	Whitish, oval, medium . .	1·47
29461 .	Somasal . .	Do. . .	Whitish, oblong, coarse . .	2·51

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
29412 . .	13·75	7·06	2·52	74·46	·76	1·45
29416 . .	13·30	6·38	2·52	75·63	·72	1·45
29417 . .	13·50	7·69	2·82	73·40	·84	1·75
29419 . .	13·55	7·06	2·58	74·40	·86	1·55
29421 . .	13·55	8·06	2·84	73·29	·76	1·50
29429 . .	13·50	9·56	2·63	72·39	·72	1·15
29432 . .	13·30	7·50	2·44	74·69	·72	1·35
29444 . .	13·25	8·44	2·94	73·26	·76	1·35
29447 . .	13·10	6·25	2·70	76·06	·64	1·25
29449 . .	13·50	6·13	2·26	76·30	·76	1·05
29451 . .	12·20	8·00	2·40	74·59	·66	1·15
29453 . .	11·95	6·88	2·28	76·92	·62	1·35
29458 . .	12·20	6·25	2·56	76·71	·78	1·50
29461 . .	12·50	6·50	2·32	76·56	·72	1·40
Average .	13·15	7·27	2·56	74·00	·74	1·38

Madras.

RICES OF MADRAS.

Rice is produced in the largest quantities in this Presidency, in the alluvial and highly irrigated districts of Tanjore, Godáveri and Kistná on the East Coast, and in Malabar and Kánara on the West Coast, where the rainfall is so abundant as to render irrigation by artificial means almost unnecessary. The extent of land taken up with grain cultivation has considerably increased of late years; it may roughly be stated to constitute one-fifth of the entire area of cultivated land.

In the Kistná district on the East Coast, rice occupies 25 per cent. of the total area under cultivation. This is of two main kinds: white paddy which is irrigated and transplanted, and black paddy which grows with the help of rain alone. The latter is largely exported to Jaffna. Owing to the alluvium Tenáli in Guntúr is the richest rice producing taluq in the Presidency. In Bellary and at Nandiál in Karnúl whence samples have been received the rice crop is small owing to the scarcity of irrigation. Further south, about Madura, rice grown under wet cultivation is the chief cereal crop, of which the variety known as *serum aman* (six months' crop) is one of the most extensive.

Main kinds.

On the West Coast rice is by far the most important staple in South Kánara where the lateritic loam in the lower stretches of the valleys constantly watered by rain and river affords the most suitable soil. The three seasons of the year correspond to the three rice crops. *Kartika* or *yenel* (May-October), *suggi* (October-January) and *kolake* (January-April). It is doubtful if any district in the Presidency shows a round of orderly and careful cultivation, and the unfailing supply of manure contributes to the quality of the grain. The *suggi* rice is inferior in quality to the *yenel* which being finer is mostly reserved for exportation, while the former is used by the cultivators for home consumption.

The finer kinds of rices from South Kánara are known under the names of *maskati*, *jorsal*, *kundapuri*, *dabansali* and *kagga*. *Balthi akki* is the generic name for raw rice in this district. *Sanna*, a rice of five months' growth, is supposed to be the best variety. In the Kásaragod taluq where the soil is exceptional the dry seed is sown broadcast early in the season and left to germinate when the first showers fall. The analyses of grain from this part point to their great superiority in albuminoids. All classes of rice are usually boiled before husking to such an extent that the husk bursts open when the paddy is dried in the sun and pounded. The better sorts when so prepared are called "maskati"

RICES OF MADRAS.

owing it is said to large quantities of it having formerly been exported to Muscat.

The samples of rice from this Presidency were received in Calcutta in January and April 1908 and analysed in March and June. The average composition is good, and particular attention should be drawn to the Kásaragod samples where high cultivation has succeeded in producing exceptionally nitrogenous grain.

Analyses.

Madras Rices.

Registration No.	Vern. name.	Locality.	Description.	Weight of 100 grains in grammes.
28073	Ladi	Coimbatore, imported from Tenali.	Reddish, translucent, long, coarse, parboiled.	1·70
28074	Molakola kulu	,, ,, ,,	White, long	1·51
28075	Kusuma kulu	,, ,, ,,	White, long, rather coarse	1·65
28076	Sirumani	,, ,, ,,	Whitish, oblong, rather coarse, parboiled.	1·63
28077	Swarnavari matta samba.	Coimbatore, imported from Palghat.	Reddish, oblong, coarse	2·18
28078	Gonda salai	Kásaragod, South Kanara.	White, oblong, fine	·84
28079	Balthi akki	,, ,, ,,	Red, oblong, coarse	2·15
28080	Jeera salai	,, ,, ,,	Whitish, long	1·68
28081	Sanna akki	Kundapur, South Kanara.	White, long	1·24
28082	Jeera salai (Mosquith)	,, ,, ,,	Reddish, coarse, parboiled	2·03
28083	Banathikai	,, ,, ,,	White, rather oblong, coarse	1·96

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
28073	8·25	6·56	·70	82·39	·70	1·40
28074	9·55	7·00	·72	81·47	·46	1·00
28075	9·10	6·25	·72	82·58	·40	·95
28076	8·70	6·87	·60	82·15	·38	1·30
28077	8·80	7·75	·72	78·93	·50	3·30
28078	9·00	8·19	·58	80·63	·40	1·20
28079	9·10	7·62	·74	81·57	·32	·65
28080	9·15	8·56	·58	80·41	·30	1·00
28081	8·75	7·31	·84	81·85	·40	·85
28082	8·40	6·75	·90	82·17	·58	1·20
28083	8·30	6·31	1·04	82·86	·54	·95
Average	8·94	7·10	·74	81·54	·43	1·25

Madras Rices—continued.

Registration No.	Vern. name.	Locality.	Description.	Weight of 100 grains in grammes.
28667 .	Sirumanian .	Madura . .	Raw rice, white, oval, coarse .	1·89
23670 .	Mattainarayan .	Do. . .	Parboiled rice, red, oblong, coarse	1·86
28671 .	Pasha pasandu .	Nandyal . .	White, long, medium . .	1·24
28674 .	Kadiri biyyam .	Do. . .	White, long, medium . .	1·60
28678 .	Yelladapu biyyam	Do. . .	Red, oblong, coarse . .	2·16
28679 .	Sambavulu .	Do. . .	Pinkish white, long, medium .	1·72
28680 .	Budama .	Do. . .	Dirty white, oblong, coarse .	2·33
28681 .	Gowri sanna biyyam.	Bellary . .	Dirty white, long, medium .	1·33
28684 .	Bili sepoy .	Do. . .	White, long, medium . .	1·35
28686 . .	Baya hunda .	Berhampur, Ganjam	Light red, long, medium . .	1·61
28690 . .	Manja molasi or Kembath.	Kollegal . .	Translucent, oblong, coarse .	2·00

Analyses.

Registration No.	Moisture.	Albuminoids.	Fat.	Carbo-hydrates.	Fibre.	Ash.
28667 . .	12·40	6·50	·98	78·22	·50	1·40
28670 . .	11·80	6·88	·72	79·31	·34	·95
28671 . .	11·90	7·75	1·38	77·65	·42	·90
28674 .	11·05	7·87	1·26	78·25	·42	1·15
28678 . .	11·40	6·75	1·20	79·27	·48	·90
28679 . .	11·90	7·87	·64	78·57	·32	·70
28680 . .	12·00	6·12	1·54	78·85	·54	·94
28681 . .	11·50	5·75	1·10	79·97	·68	1·00
28684 . .	12·00	6·56	·74	79·29	·66	·75
28686 . .	11·75	7·18	·66	79·01	·60	·80
28690 . .	11·35	5·75	1·14	79·96	·50	1·30
Average .	11·73	6·82	1·03	78·94	·50	·98

Summary.

SUMMARY.

Average compositions.

The results of the analyses of one hundred and fifty-nine samples of Indian rice are here tabulated for easy reference:—

	Samples.	Water.	Protein.	Fat.	Carbo-hydrates.	Fibre.	Ash
Bengal . .	14	11·10	7·51	·40	79·82	·44	·73
Bengal . . .	12	12·37	7·09	·40	78·86	·48	·80
Eastern Bengal and Assam.	16	11·19	7·67	·53	79·21	·58	·82
Burma . . .	10	11·54	7·54	·98	78·59	·58	·77
Cuttack . .	11	10·92	6·58	·31	80·81	·35	1·03
Central Provinces .	7	9·05	6·68	·88	82·05	·42	·92
United Provinces .	10	10·03	7·44	2·83	77·14	1·00	1·56
Nepal . . .	13	11·28	7·50	·85	79·13	·32	·92
Punjab . .	14	12·89	6·98	·36	78·63	·39	·75
Bombay . .	16	12·61	7·69	2·65	74·63	·89	1·53
Bombay . .	14	13·15	7·27	2·56	74·90	·74	1·38
Madras . . .	11	8·94	7·10	·74	81·54	·43	1·25
Madras . .	11	11·69	6·81	1·03	79·00	·49	·98

It is thus seen that the average percentage of protein in these rices is 7·25, with the highest in East Bengal and Assam and Bombay and the lowest in Cuttack and the Central Provinces. But the most interesting conclusions are drawn from the individual analyses where the percentage varies from 9·81 in a sample from Broach to 5·44 in a sample from Cuttack. One object in conducting these examinations has been to discover what natural circumstances have contributed to the superiority of the composition of the grain. It has been seen that in some cases the local reputation and market value of the rice coincides with the high nitrogen content. This is noticed in the *kalojera* and *bank tulsi* rices of East Bengal and Assam, the *kapurkanta* and rice for *mudi* of Cuttack, the *samudrafin*, *samjira*, *basmati* and *gouria* from Nepál, and the *kamod* and *bengali* of Bombay. In other cases there is no connection between the high market value and the nitrogen contents as instanced in the *dadkhani* rice of Bengal. The examination has resulted in giving a prominent place to certain rices which deserve attention at the hands of cultivators. Among these may be mentioned the *chhata balam* of Neragirza, the *chhilait atab* of Rájáhát, the *ghunchi* and *dudhya motul* of Khulná, and the *lali bagra* of Bhágálpur, all of Bengal, the

sonamukhi of Chittagong and the *baradhan* of Tezpur, the *lal bagri* of Rái Bareli, the *rhiand* of Suket, Punjáb, the *dhimdhani* of Broach, *ambemohar* of Belgáum and the *jeera salai* of South Kánara, all of which contain over 8 per cent. of albuminoids.

SUMMARY.

The richness of the grain appears to be due not so much to the races of the plant or the appearance of the grain as to the cultivation. The grain of finest composition are found in plants grown in rich virgin soil or in lands liberally manured. Instances of this kind are found in the red rice grown in *taungya* by the Chins of Burma, in the Kanapur rices of the Karnátic, and in the Kásaragod rices of South Kánara on the Western Coast. Attention to the cultivation of the rice plants in the way of manuring the land appears to be one of the principal means of improving the quality of the grain for commercial and edible purposes.

Richness of grain seems to depend much on cultivation.

TABLE I.

Arranged according to the percentage, on dry weight, of carbohydrates found in the various rices.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Carbo-hydrates.	Albumi-noids.	Fat.	Fibre.	Ash.	Page.
1	Lajuk badan, 25,976	H. atap	Cuttack . .	92·22	6·58	·32	·20	·68	77
2	Motsafa, 25,989 .	H.	Ditto . . .	92·18	6·06	·25	·40	1·11	77
3	Dadkhani, 25,467 .	H.	Haripur or Dinajpur.	91·93	6·46	·11	·48	1·02	70
4	Chini shakkar, 25,465 .	H.	Abdalpur . .	91·89	7·00	·11	·49	·51	70
5	Mach kanta 25,979 .	H. atap	Cuttack . .	91·69	6·31	·54	·34	1·12	77
6	Katari bhog, 26,767 .	H.	Naogaon, Rajshahi	91·65	7·37	·25	·22	·51	73
7	Sittisal, 25,471 . .	H.	Rajahat . .	91·39	7·00	·32	·34	·95	70
8	Mungi, 25,955 . .	H.	Birampore . .	91·16	7·00	·32	·78	·74	71
9	Hansraj, 25,745 . .	H.	Suket . . .	91·12	7·14	·48	·46	·80	83
10	Geri, 25,981 . .	H.	Cuttack . .	91·03	6·93	·38	·38	1·23	77
11	Chilakat, 28,085 .	M.	Raipur . .	91·06	6·88	·77	·46	·83	78
12	Basumati, 25,754 .	H.	Amritsar . .	91·00	7·85	·21	·25	·69	83
13	Patna table rice, 26,206	H.	Calcutta market .	90·92	7·66	·30	·55	·57	71
14	Kusuma kulu, 28,075 .	H.	Coimbatore imported from Tenali.	90·85	6·88	·79	·44	1·04	88
15	Jhinjhin, 25,752 . .	H. atap	Suket . . .	90·81	7·20	·72	·46	·81	83
16	Hansa, 28,088 . .	M.	Raipur . . .	90·77	6·87	·92	·40	1·04	78
17	Bhojri, 28,087 . .	M.	Ditto . . .	90·75	6·84	·97	·44	1·00	78
18	Balessari, 28,031 .	H.	Raxaul, Champaran.	90·69	7·66	·56	·25	·84	81
19	Chokha chanti, 25,958	H.	Gaya . . .	90·67	7·95	·21	·31	·86	71
20	Katari bhog, 25,960 .	H.	Dinajpur . .	90·60	7·53	·37	·53	·97	71
21	Nanhia, 25,959 . .	H.	Ditto . .	90·57	7·48	·27	·53	1·15	71
22	Roopsal, 25,466 . .	H.	Rajahat . .	90·57	7·78	·18	·68	·79	70
23	Kubri mohar, 28,084 .	M.	Raipur . . .	90·54	6·87	·99	·44	1·16	78
24	Baytee (Desi), 26,407 .	H. atap	Chittagong . .	90·52	7·14	·94	·56	·84	73
25	Nal tukri, 25,993 .	H.	Cuttack . .	90·46	7·54	·25	·40	1·35	77
26	Bogra, 25,743 . .	H.	Sirmur . .	90·45	7·55	·46	·51	1·03	83
27	Sirmaoribegmi, 25,755.	M.	Ditto . .	90·43	7·49	·48	·73	·87	83

Arranged according to the percentage, on dry weight, of carbohydrates found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Carbo-hydrates.	Albumi-noids.	Fat.	Fibre.	Ash.	Page.
28	Handa, 25,975 . .	H.	Cuttack . .	90·40	7·53	·34	·38	1·35	77
29	Basful, 28,030 . .	H.	Raxaul, Champa-ran.	90·39	7·58	·77	·31	·95	81
30	Nga-sein, 21,760 . .	H.	Pegu . . .	90·39	7·88	·27	·60	·86	75
31	Rice for mudi, 25,987 .	H.	Cuttack . .	90·38	8·09	·23	·29	1·01	77
32	Patna table rice, 26,208	H.	Calcutta market .	90·37	8·08	·59	·27	·69	71
33	Rhinjri, 25,751 . .	H.	Andur, Bilaspur .	90·37	8·21	·25	·37	·80	83
34	Gowri sanna biyyam, 28,681.	H.	Bellary . .	90·36	6·50	1·24	·77	1·13	89
35	Banathikai, 28,083 .	M.	Kundapur, South Kanara.	90·35	6·88	1·14	·59	1·04	88
36	Bank tulsi, 25,468 .	H.	Abdalpur . . .	90·35	8·40	·13	·39	·73	70
37	Sukhdas, 25,753 . .	H.	Palampur . .	90·34	8·16	·23	·53	·74	83
38	Manmohini, 25,470 .	H.	Fatehpur . . .	90·29	8·61	·22	·27	·61	70
39	Tira, 25,744. . .	H.	Kangra . .	90·27	7·66	·43	·61	1·03	83
40	Jara marsi, 28,041 .	H. atap	Khatmandu . .	90·23	7·55	1·02	·29	·91	81
41	Old Lard Patna rice, 26,207.	H.	Calcutta market .	90·21	8·66	·27	·23	·63	71
42	Kalan, 25,749 . .	H.	Sirmur . .	90·21	8·40	·34	·25	·80	83
43	Manjamolasi or Kem-batth, 28,690.	H.	Kollegal . .	90·20	6·49	1·28	·56	1·47	89
44	Mach kanta, 25,985 .	H.	Cuttack . .	90·20	7·50	·45	·56	1·29	77
45	Rajimani, 26,649. .	H.	Futalla, Bogra .	90·17	7·47	·65	·81	·90	73
46	Katari bhog, 25,957 .	H.	Bhagalpur . .	90·14	8·34	·23	·43	·86	71
47	Bili sepoy, 28,684 .	H.	Bellary . .	90·10	7·46	·84	·75	·85	89
48	Basmati, 28,037 . .	H.	Khatmandu .	90·07	8·25	·70	·25	·73	81
49	Basumati, 25,983 .	M.	Cuttack . .	90·06	8·11	·38	·43	1·02	77
50	Laxmi bhog, 28,090	M.	Raipur . .	90·01	7·92	·70	·44	·93	78
51	Sirumani, 28,076. .	.	Coimbatore, import-ed from Tenali	89·98	7·52	·66	·42	1·42	88
52	Mattainarayan, 28,670.	H.	Madura . .	89·92	7·80	·82	·38	1·08	89
53	Rato marsi, 28,035 .	H.	Khatmandu . .	89·92	7·66	1·15	·31	·96	81
54	Aman, 26,059 . .	H.	Chandpur . .	89·92	7·65	·18	·85	1·40	73

Arranged according to the percentage, on dry weight, of carbohydrates found the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Carbo-hydrates.	Albumi-noids.	Fat.	Fibre.	Ash.	Pag
55	Ramjamani, 25,756 .	H.	Punjab . .	89·91	8·47	·30	·39	·93	83
56	Kamal bhog, 25,469 .	H.	Rajahat . .	89·90	8·44	·38	·55	·73	70
57	Molakola kulu, 28,074.	M.	Coimbatore, imported from Tenali.	89·87	7·72	·80	·51	1·10	88
58	Bardhana, 26,062 .	H. atap	Rangoon . .	89·87	8·51	·56	·50	·56	75
59	Khayan chain, 26,389 .	M.	Kyauktaw, Akyab	89·84	8·12	1·08	·45	·51	75
60	Bansmati, 25,746 .	M.	... Punjab	89·81	8·87	·21	·25	·86	83
61	Ladi, 28,073 . .	H.	Coimbatore, imported from Tenali.	89·80	7·15	·76	·76	1·53	88
62	Chaba, 28,047 . .	H.	Khatmandu . .	89·76	8·24	·83	·38	·79	81
63	Ujla, 25,748. . .	H. atap	Sirmur. . .	89·76	8·00	·69	·57	·98	83
64	Balthi akki, 28,079 .	M.	Kásaragod, South Kanara.	89·74	8·38	·81	·35	·72	88
65	Lajuk badan, 25,978 .	M.	Cuttack . .	89·74	8·54	·25	·34	1·13	77
66	Kumbi, 26,754 . .	M.	Manipur . .	89·72	8·61	·54	·45	·68	73
67	Jeera salai (Mosquith), 28,082.	H.	Kundapur, South Kanara.	89·71	7·37	·98	·63	1·31	88
68	Gouria, 28,038 . .	H.	Khatmandu . .	89·71	8·29	·77	·32	·91	81
69	Sanna akki, 28,081 .	M.	Kundapur, South Kanara.	89·70	8·01	·92	·44	·93	88
70	Rangooni chal, 25,626.	H. atap	Rangoon . .	89·70	8·43	·70	·38	·79	75
71	Bank tulsi, 26,052 .	H.	Mymensingh .	89·68	9·18	·11	·47	·56	73
72	... 31,310 .	M.	Rangoon .	89·65	8·63	·49	·50	·73	75
73	Kasiatu, 25,747 .	H.	Arki and Bilaspur	89·62	7·83	·68	·91	·96	83
74	Budama, 28,680 . .	H.	Nandyal . .	89·60	6·96	1·75	·61	1·08	89
75	Nagra, 26,074 . .	H. atap	Bardwan . .	89·59	8·92	·43	·43	·63	71
76	Chanti, 25,956 . .	H.	Phulbari . .	89·57	7·62	·68	·76	1·37	71
77	Baya hunda 28,686 .	H.	Berhampur, Ganjam.	89·53	8·13	·75	·68	·91	89
78	Kapur kanta, 25,986 .	H.	Cuttack . .	89·53	8·13	·35	·55	1·44	77
79	Gurmatia, 28,086. .	M.	Raipur . .	89·51	8·02	·93	·60	·94	78
80	Yella dapu biyyam, 28,678.	H. atap	Nandyal . .	89·47	7·62	1·35	·54	1·02	89

Arranged according to the percentage, on dry weight, of carbohydrates found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Carbohydrates.	Albuminoids.	Fat.	Fibre.	Ash.	Page.
81	Shiti patanai, 25,462 .	H.	Mundra Bazar .	89·43	8·86	·45	·58	·68	70
82	Krishen bhog, 28,046 .	H.	Khatmandu . .	89·41	8·89	·64	·27	·79	81
83	Kamini, 25,463 . .	H.	Rangamatti . .	89·34	8·45	·85	·40	·96	70
84	Pati dhan, 26,063 .	H. atap	Goalpara . .	89·32	8·52	·75	·73	·68	73
85	Sirumanian, 28,667 .	H.	Madura . .	89·29	7·42	1·12	·57	1·60	89
86	Sambavulu, 28,679 .	H.	Nandyal . .	89·18	8·93	·73	·36	·80	89
87	Gulab sooroo, 25,461 .	H.	Rangamatti . .	89·07	8·44	·79	·68	1·02	70
88	Kauk-nyin, 21,761 .	H.	Pegu . . .	89·05	9·24	·48	·26	·97	75
89	Rhiand, 25,750 . .	H.	Suket . . .	89·00	9·30	·34	·56	·80	83
90	Nakenjee, 26,387 .	M.	Kyauktaw, Akyab	88·98	7·93	1·50	·68	·91	75
91	Touli, 28,044 . .	H. atap	Khatmandu . .	88·97	8·85	·95	·32	·91	81
92	Kalojira, 26,049 . .	H. atap	Mymensingh .	88·91	9·31	·31	·69	·78	73
93	Samjira, 28,036 , .	H.	Khatmandu . .	88·90	8·77	1·00	·31	1·02	81
94	Chini kapur, 28,089 .	M.	Raipur . . .	88·89	7·99	1·44	·48	1·20	78
95	Chhata balam, 25,464 .	H.	Neragirza, Calcutta.	88·89	9·52	·40	·24	·95	70
96	Horuchikan (new), 26,398.	H.	Buthidaung, Akyab District.	88·83	8·28	1·28	·83	·78	75
97	Aus chal or bitrichal, 26,053.	H.	Dhubri . .	88·70	8·88	·40	·91	1·11	73
98	Gonda salai, 28,078 .	M.	Kasaragod, South Kanara.	88·60	9·00	·64	·44	1·32	88
99	Aus, 26,058 . .	H.	Chandpur . .	88·57	9·16	·53	·85	·89	73
100	Fooren, 26,749 . .	M.	Manipur . .	88·53	9·38	·77	·47	·85	73
101	Maniki madhuri or Kunkunia jaha, 26,690.	H.	Tezpur . .	88·52	9·19	·88	·50	·91	73
102	Jeera salai, 28,080 .	M.	Kasaragod, South Kanara.	88·51	9·42	·64	·33	1·10	88
103	Dudhya motal, 25,625 .	M.	Khulna . .	88·47	9·33	·74	·67	·79	70
104	Boka or komal, 26,687.	H.	Tezpur . .	88·45	8·01	·98	·91	1·65	73
105	Bardhana, 26,061 .	H.	Goalpara . .	88·45	9·11	·51	·87	1·06	73
106	Samudrafin, 28,039 .	H.	Khatmandu . .	88·37	9·94	·63	·27	·79	81
107	Halga, 29,449 . .	H.	Kanara . .	88·21	7·09	2·61	·88	1·21	86
108	Pasha pasandu, 28,671 .	H.	Nandyal . .	88·14	8·80	1·56	·48	1·02	89

Arranged according to the percentage, on dry weight, of carbohydrates found in t various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Carbo-hydrates.	Albumi-noids.	Fat.	Fibre.	Ash.	Pa
109	Bara dhan, 26,689 .	M.	Tezpur . .	88·05	9·66	·71	·61	·97	
110	Nagra, 26,075 . .	H.	Bardwan . .	88·03	8·43	1·38	·92	1·24	
111	Lall bagra, 25,954 .	H.	Bhagalpur . .	88·03	9·44	·41	·87	1·25	
112	Kadiri biyyam, 28,674.	H.	Nandyal . .	87·98	8·85	1·41	·47	1·29	
113	Sonamukhi, 26,406 .	H.	Chittagong . .	87·92	9·52	1·06	·49	1·01	
114	Chhilait atab, 25,472 .	H. atap	Rajahat . .	87·86	9·92	·81	·51	·90	
115	Ghunchi, 25,624 . .	M.	Khulna . .	87·61	10·09	·81	·64	·85	
116	Sadharam pandhara, 29,447.	H.	Chikodi . .	87·52	7·19	3·11	·74	1·44	
117	Somasal, 29,461 . .	H.	Kanara . .	87·50	7·43	2·65	·82	1·60	
118	Burmalgi, 29,458 .	H.	Ditto . . .	87·37	7·12	2·92	·89	1·70	
119	Dudhi saru, 28,029 .	H.	Raxaul, Champa-ran.	87·37	8·65	1·27	·65	2·06	
120	Hukeri rice No. 1, 29,453.	H.	Hukeri . .	87·36	7·81	2·59	·71	1·53	
121	Dodagen kirsali bhatta, 29,416.	H.	Sampgaon . .	87·23	7·36	2·91	·83	1·67	
122	Gunga, 28,448 . .	H.	Lower Sind . .	86·89	7·80	2·18	1·18	1·95	
123	... 26,408 . .	H.	Krin-Chaung, Northern Arakan.	86·75	9·33	1·80	1·05	1·07	
124	Dodka sal, 29,122 .	H.	Dhulia . .	86·64	7·72	3·13	·85	1·66	
125	Sukhvel, 28,863 . .	H.	Broach . .	86·60	7·84	3·14	1·09	1·33	
126	... 28,450 . .	H.	Grown in the Nara valleys of the Thar and Parkar District, Sind.	86·58	7·23	3·29	1·40	1·50	
127	Swarnavarimatha samba, 28,077.		Coimbatore, import-ed from Palghat.	86·54	8·50	·79	·55	3·62	
128	Kada, 28,864 . .	H.	Olpad, Surat .	86·47	7·89	2·89	1·07	1·63	
129	Sufedka, 30,648 . .	H.	Faizabad District	86·42	7·65	3·08	1·05	1·80	
130	Dhana sal, 29,123 .	H.	Dhulia . .	86·36	8·36	2·75	·87	1·66	
131	Sali bhatta, 29,412 .	H.	Sampgaon . .	86·33	8·19	2·92	·88	1·68	
132	Jadi sal, 29,121 . .	H.	Dhulia . .	86·28	8·09	2·75	·87	2·01	
133	Gandawa, 30,664 . .	H.	Rai Bareli . .	86·20	7·89	3·08	1·11	1·72	

Arranged according to the percentage, on dry weight, of carbohydrates found in the various rices—concld.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Carbohydrates.	Albuminoids.	Fat.	Fibre.	Ash.	Page.
134	Madhali atsal, 29,432 .	H.	Belgaum . .	86·15	8·65	2·81	·83	1·56	86
135	Karangi, 30,651 . .	H.	Benares . .	86·12	7·80	3·27	1·14	1·67	79
136	Dehula, 30,661 . .	H.	Rai Bareli . .	86·08	8·46	2·82	1·20	1·44	79
137	Sanna bhatta Kirsali, 29,419.	H.	Sampgaon . .	86·06	8·17	2·98	1·00	1·79	86
138	Lalka or Rambhog, 30,649.	H.	Faizabad District	85·96	7·97	3·27	1·12	1·68	79
139	Dodaga, 29,451 . .	H.	Chandagad . .	85·93	9·22	2·77	·76	1·32	86
140	Shanzira, 30,655 . .	H.	Benares . .	85·91	8·37	2·94	·97	1·81	79
141	Monghi salia, 28,867 .	H.	Bardoli, Surat .	85·82	9·04	2.85	·85	1·44	85
142	Kada, 28,866 . .	H.	Chikli, Surat .	85·82	8·68	3·01	·93	1·56	85
143	Hakua, 28,048 . .	H.	Khatmandu .	85·71	9·61	2·11	·83	1·74	81
144	Ratria (*i. e.*, inclined to red), 28,449.	H.	Lower Sind . .	85·55	8·48	3·01	1·18	1·78	85
145	Matian (*viz.*, pearly), 28,447.	H.	Ditto . .	85·54	8·14	2·72	1·20	2·40	85
146	Harkeswa, 30,646 .	H.	Faizabad District	85·52	8·33	3·16	1·16	1·83	79
147	Lajura or Jillaur, 30,657.	H.	Benares . .	85·42	8·39	3·31	1·14	1·74	79
148	Ambon, 26,384 . .	H.	Kyauk-taw, Akyab	85·38	8·89	2·89	1·25	1·59	75
149	Badarphui or Badshapasand, 30,665.	H.	Rai Bareli .	85·35	8·28	3·54	1·05	1·78	79
150	Kolam, 28,862 . .	H.	Chikli, Surat .	85·31	9·12	3·13	·88	1·56	85
151	Kare ambemohar, 29,417.	H.	Sampgaon . .	84·86	8·89	3·26	·97	2·02	86
152	Kala jirga, 29,421 .	H.	Chandagad . .	84·78	9.32	3·29	·88	1·73	86
153	Bhusalia, 28,865 .	H.	Chikli, Surat .	84·69	9·44	3·35	·85	1·67	85
154	Ambemohar (white), 29,444.	H.	Belgaum . .	84·45	9·73	3·39	·87	1·56	86
155	Lalbagri, 30,658 . .	H.	Rai Bareli . .	84·43	9·47	3·03	1·25	1·82	79
156	Ambersal (small), 29,429.	H.	Khanapur . .	83·69	11·05	3·10	·83	1·33	86
157	Bengalia, 28,860 . .	H.	Chikli, Surat .	83·13	10·48	3·45	1·07	1·87	85
158	Dhundhani, 28,861 .	H.	roach . .	82·32	11·35	3·36	1·06	1·91	85
159	Kamod, 29,337 . .	H.	Dhulia . .	82·17	11·36	3·56	·93	1·98	85

TABLE II.

Arranged according to the percentage, on dry weight, of alkuminoids found in t various rices.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.	Pa
1	Kamod, 29,337 . .	H.	Dhulia . . .	11·36	3·56	82·17	·93	1·98	8
2	Dhundhani, 28,861 .	H.	Broach . .	11·35	3·36	82·32	1·06	1·91	8
3	Ambersal (small), 29,429	H.	Khanapur . .	11·05	3·10	83·69	·83	1·33	8
4	Bengalia, 28,860 . .	H.	Chikli, Surat .	10·48	3·45	83·13	1·07	1·87	8
5	Ghunchi, 25,624 . .	M.	Khulna . .	10·09	·81	87·61	·64	·85	7
6	Samudrafin, 28,039 .	H.	Khatmandu . .	9·94	·63	88·37	·27	·79	8
7	Chhilait atab, 25,472 .	H. atap	Rajahat . .	9·92	·81	87·86	·51	·90	7
8	Ambemohur (white) 29,444.	H.	Belgaum . .	9·73	3·39	84·45	·87	1·56	8
9	Baradhan, 26,689 .	M.	Tezpur . .	9·66	·71	88·05	·61	·97	7
10	Hakua, 28,048 . .	H.	Khatmandu . .	9·61	2·11	85·71	·83	1·74	8
11	Sonamukhi, 26,406 .	H.	Chittagong . .	9·52	1·06	87·92	·49	1·01	7
12	Chhata balam, 25,464 .	H.	Neragirza, Calcutta	9·52	·40	88·89	·24	·95	7
13	Lalbagri, 30,658 . .	H.	Rai Bareli . .	9·47	3·03	84·43	1·25	1·82	7
14	Bhusalia, 28,865 . .	H.	Chikli, Surat .	9·44	3·35	84·69	·85	1·07	8
15	Lall bagra, 25,954 .	H.	Bhagalpur . .	9·44	·41	88·03	·87	1·25	7
16	Jeera salai, 28,980 .	M.	Kasaragod, South Kanara.	9·42	·64	88·51	·33	1·10	8
17	Fooren, 26,749 . .	M.	Manipur . .	9·38	·77	88·53	·47	·85	7
18	Dudhya motal, 25,625 .	M.	Khulna . .	9·33	·74	88·47	·67	·79	7
19	... 26,408 .	H.	Krin-Chaung, Northern Arakan.	9·33	1·80	86·75	1·05	1·07	7
20	Kala jirga, 29,421 .	H.	Chandagad . .	9·32	3·29	84·78	·88	1·73	8
21	Kalojira, 26,049 . .	H. atap	Mymensingh .	9·31	·31	88·91	·69	·78	7
22	Rhiand, 25,750 . .	H.	Suket . . .	9·30	·34	89·00	·56	·80	8
23	Kauk-nyin, 21,761 .	H.	Pegu . . .	9·24	·48	89·05	·26	·97	7
24	Dodaga, 29,451 . .	H.	Chandagad . .	9·22	2·77	85·93	·76	1·32	8
25	Manikimadhuri or Kunkunia jaha, 26,690.	H.	Tezpur . .	9·19	·88	88·52	·50	·91	7
26	Bank tulsi, 26,052 .	H.	Mymensingh .	9·18	·11	89·68	·47	·56	7
27	Aus, 26,058 . . .	H.	Chandpur . .	9·16	·53	88·57	·85	·89	7

Arranged according to the percentage, on dry weight, of albuminoids found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.	Page.
28	Kolam, 28,862 . .	H.	Chikli, Surat .	9·12	3·13	85·31	·88	1·56	85
29	Bardhana, 26,061. .	H.	Goalpara . .	9·11	·51	88·45	·87	1·06	73
30	Monghi salia, 28,867 .	H.	Bardoli, Surat .	9·04	2·85	85·82	·85	1·44	85
31	Gonda salai, 28,078 .	M.	Kasaragod, South Kanara.	9·00	·64	88·60	·44	1·32	88
32	Samba vulu, 28,679 .	H.	Nandyal . .	8·93	.73	89·18	·36	·80	89
33	Nagra, 26,074 . .	H. atap	Bardwan . .	8·92	·43	89·59	·43	·63	71
34	Krishen bhog, 28,046 .	H.	Khatmandu . .	8·89	·64	89·41	·27	·79	81
35	Kare ambemohar, 29,417.	H.	Sampgaon . .	8·89	3·26	84·86	·97	2·02	86
36	Ambon, 26,384 . .	H.	Kyauktaw, Akyab	8·89	2·89	85·38	1·25	1·59	75
37	Aus chal or bitri chal, 26,053.	H.	Dhubri . .	8·88	·40	88·70	·91	1·11	73
38	Bansmati, 25,746 .	M.	... Punjab .	8·87	·21	89·81	·25	·86	83
39	Shiti patanai, 25,462 .	H.	Mundra Bazar .	8·86	·45	89·43	·58	·68	70
40	Touli, 28,044 . .	H. atap	Khatmandu . .	8·85	·95	88·97	·32	·91	81
41	Kadiri biyyam, 28,674 .	H.	Nandyal . .	8·85	1·41	87·98	·47	1·29	89
42	Pasha pasendu, 28,671.	H.	Ditto . .	8·80	1·56	88·14	·48	1·02	89
43	Samjira, 28,036 . .	H.	Khatmandu . .	8·77	1·00	88·90	·31	1·02	81
44	Kada, 28,866 . .	H.	Chikli, Surat .	8·68	3·01	85·82	·93	1·56	85
45	Old Lard Patna Rice, 26,207.	H.	Calcutta market .	8·66	·27	90.21	·23	·63	71
46	Madhali atsal, 29,432 .	H.	Belgaum . .	8·65	2·81	86·15	·83	1·56	86
47	Dudhi saru, 28,029 .	H.	Raxaul, Champaran.	8·65	1·27	87·37	·65	2·06	81
48	... 31,310 .	M.	Rangoon . .	8·63	·49	89·65	·50	·73	75
49	Kumbi, 26,754 . .	M.	Manipur . .	8·61	·54	89·72	·45	·68	73
50	Manmohini, 25,470 .	H.	Fatehpur . .	8·61	·22	90·29	·27	·61	70
51	Lajuk badan, 25,978 .	M.	Cuttack . .	8·54	·25	89·74	·34	1·13	77
52	Pati dhan, 26,063 .	H. atap	Goalpara . .	8·52	·75	89·32	·73	·68	73
53	Bardhana, 26,062 .	H. atap	Rangoon . .	8·51	·56	89·87	·50	·56	75
54	Swarnavarimatta, samba, 28,077.	H.	Coimbatore imported from Palghat.	8·50	·79	86·54	·55	3·62	88

Arranged according to the percentage, on dry weight, of albuminoids found the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.	P
55	Ratria (*i.e.*, inclined to red), 28,449.	H.	Lower Sind . .	8·48	3·01	85·55	1·18	1·78	
56	Ramjamani, 25,756 .	H.	... Punjab .	8·47	·30	89·91	·39	·93	
57	Dehula, 30,661 . .	H.	Rai Bareli . .	8·46	2·82	86·08	1·20	1·44	
58	Kamini, 25,463 .	H.	Rangamatti . .	8·45	·85	89·34	·40	·96	
59	Gulab sooroo, 25,461 .	H.	Ditto . .	8·44	·79	89·07	·68	1·02	
60	Kamal bhog, 25,469 .	H.	Rajahat . .	8·44	·38	89·90	·55	·73	
61	Nagra, 26,075 . .	H.	Bardwan . .	8·43	1·38	88·03	·92	1·24	
62	Rangooni chal, 25,626 .	H. atap	Rangoon . .	8·43	·70	89·70	·38	·79	
63	Kalan, 25,749 . .	H.	Sirmur . .	8·40	34	90·21	·25	·80	
64	Bank tulsi, 25,468 .	H.	Abdalpur . .	8·40	·13	90·35	·39	·73	
65	Lajura or Jillaur, 30,657	H.	Benares . .	8·39	3·31	85·42	1·14	1·74	
66	Balthi akki, 28,079 .	M.	Kasaragod, South Kanara.	8·38	·81	89·74	·35	·72	
67	Shanzira, 30,655 . .	H.	Benares . .	8·37	2·94	85·91	·97	1·81	
68	Dhana sal, 29,123 . .	H.	Dhulia . . .	8·36	2·75	86·36	·87	1·66	
69	Katari bhog, 25,957 .	H.	Bhagalpur . .	8·34	·23	90·14	·43	·86	
70	Harkeswa, 30,646 .	H.	Faizabad District.	8·33	3·16	85·52	1·16	1·83	
71	Gouria, 28,038 . .	H.	Khatmandu . .	8·29	·77	89·71	·32	·91	
72	Badarphui or Badahapasand, 30,665.	H.	Rai Bareli . .	8·28	3·54	85·35	1·05	1·78	
73	Haruchikan (new), 26,398.	H.	Buthidaung, Akyab District.	8·28	1·28	88·83	·83	·78	
74	Basmati, 28,037 . .	H.	Khatmandu . .	8·25	·70	90·07	·25	·73	
75	Chaba, 28,047 . .	H.	Ditto . .	8·24	·83	89·76	·38	·79	
76	Rhinjri, 25,751 . .	H.	Andur, Bilaspur .	8·21	·25	90·37	·37	·80	
77	Sali bhatta, 29,412 .	H.	Sampgaon . .	8·19	2·92	86·33	·88	1·68	
78	Sanna bhatta kirsali, 29,419.	H.	Ditto . .	8·17	2·98	86·06	1·00	1·79	
79	Sukhdas, 25,753 . .	H.	Palampur . .	8·16	·23	90·34	·53	·74	
80	Matian (*viz.*, pearly), 28,447.	H.	Lower Sind . .	8·14	2·72	85·54	1·20	2·40	
81	Kapur kanta, 25,986 .	H.	Cuttack . .	8·13	·35	89·53	·55	1·44	
82	Baya hunda, 28,686 .	H.	Berhampur, Ganjam	8·13	·75	89·53	·68	·91	

Arranged according to the percentage, on dry weight, of albuminoids found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.	Page.
83	Khayan chain, 26,389 .	M.	Kyauktaw, Akyab.	8·12	1·08	89·84	·45	·51	75
84	Basumati, 25,983 .	M.	Cuttack . .	8·11	·38	90·06	·43	1·02	77
85	Jadi sal, 29,121 . .	H.	Dhulia . .	8·09	2·75	86·23	·87	2·01	85
86	Rice for mudi, 25,987 .	H.	Cuttack . .	8·09	·23	90·38	·29	1·01	77
87	Patna table rice, 26,203 .	H.	Calcutta market .	8·08	·59	90·37	·27	69	71
88	Gurmatia, 28,086 . .	M.	Raipur . . .	8·02	·93	89·51	·60	·94	78
89	Boka or komal, 26,687 .	H.	Tezpur . . .	8·01	·98	88·45	·91	1·65	73
90	Sanna akki, 28,081 .	M.	Kundapur, South Kanara.	8·01	·92	89·70	·44	·93	88
91	Ujla, 25,748 . .	H. atap	Sirmur . . .	8·00	·69	89·76	·57	·98	83
92	Chini kapur, 28,089 .	M.	Raipur . . .	7·99	1·44	88·89	·48	1·20	78
93	Lalka or Ram bhog, 30,649.	H.	Faizabad District.	7·97	3·27	85·96	1·12	1·68	79
94	Chokha chanti, 25,958 .	H.	Gaya . . .	7·95	·21	90·67	·31	·86	71
95	Nakenjee, 26,387 .	M.	Kyauktaw, Akyab.	7·93	1·50	88·98	·68	·91	75
96	Laxmi bhog, 28,090 .	M.	Raipur. . .	7·92	·70	90·01	·44	·93	78
97	Gondawa, 30,664. .	H.	Rai Bareli . .	7·89	3·08	86·20	1·11	1·72	79
98	Kada, 28,864 . .	H.	Olpad, Surat .	7·89	2·89	86·47	1·07	1·68	85
99	Nga-sein, 21,760 . .	H.	Pegu . . .	7·88	·27	90·39	·60	·86	75
100	Basumati, 25,754. .	H.	Amritsar . .	7·85	·21	91·00	·25	·69	83
101	Sukhvel, 28,863 . .	H.	Broach . .	7·84	3·14	86·60	1·09	1·33	85
102	Kasiatu, 25,747 . .	H.	Arki and Bilaspur	7·83	·68	89·62	·91	·96	83
103	Hukeri rice No. 1, 29,453.	H.	Hukeri . .	7·81	2·59	87·36	·71	1·53	86
104	Gunga, 28,443 . .	H.	Lower Sind . .	7·80	2·18	86·89	1·18	1·95	85
105	Mattainarayan, 28,670.	H.	Madura . .	7·80	·82	89·92	·38	1·08	89
106	Karangi, 30,651 . .	H.	Benares . .	7·80	3·27	86·12	1·14	1·67	79
107	Roopsal, 25,466 . .	H.	Rajahat . .	7·78	·18	90·57	·68	·79	70
108	Dodka sal, 29,122 .	H.	Dhulia . .	7·72	3·13	86·64	·85	1·66	85
109	Molakola kulu, 28,074.	M.	Coimbatore, imported from Tenali.	7·72	·80	89·87	·51	1·10	88
110	Patna table rice, 26,206	H.	Calcutta market ,	7·66	·30	90·92	·55	·57	71

Arranged according to the percentage, on dry weight, of albuminoids found in th various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.	Page
111	Balessari, 28,031. .	H.	Raxaul, Champaran.	7·66	·56	90·69	·25	·84	81
112	Tira, 25,744 . .	H.	Kangra . .	7·66	·43	90·27	·61	1·03	83
113	Rato marsi, 28,035 .	H.	Khatmandu . .	7·66	1·15	89·92	·31	·96	81
114	Aman, 26,059 . .	H.	Chandpur . .	7·65	·18	89·92	·85	1·40	73
115	Sufedka, 30,648 . .	H.	Faizabad District.	7·65	3·08	86·42	1·05	1·80	79
116	Yelladapu biyyam, 28,678.	H. atap	Nandyal . .	7·62	1·35	89·47	·54	1·02	89
117	Chanti, 25,956 . .	H.	Phulbari . .	7·62	·68	89·57	·76	1·37	71
118	Basful, 28,030 . .	H.	Raxaul, champaran.	7·58	·77	90·39	·31	·95	81
119	Bogra, 25,743 .	H.	Sirmur . .	7·55	·46	90·45	·51	1·03	83
120	Jara marsi, 28,041 .	H. atap	Khatmandu . .	7·55	1·02	90·23	·29	·91	81
121	Nal tukri, 25,993 . .	H.	Cuttack . .	7·54	·25	90·46	·40	1·35	77
122	Handa, 25,975 . .	H.	Ditto . .	7·52	·34	90·40	·38	1·35	77
123	Katari bhog, 25,960 .	H.	Dinajpur . .	7·53	·37	90·60	·53	·97	71
124	Sirumani, 28,076. .	H.	Coimbatore, imported from Tenali.	7·52	·66	89·98	·42	1·42	88
125	Mach kanta, 25,985 .	H.	Cuttack . .	7·50	·45	90·20	·56	1·29	77
126	Sirmaoribegmi, 25,755.	M.	Sirmur . . .	7·49	·48	90·43	·7	·87	83
127	Nanhia, 25,959 . .	H.	Dinajpur . .	7·48	·27	90·57	·53	1·15	71
128	Rajimani, 26,649 . .	H.	Futalla, Bogra .	7·47	·65	90·17	·81	·90	73
129	Bili sepoy, 28,684 .	H.	Bellary . .	7·46	·84	90·10	·75	·85	89
130	Somasal, 29,461 . .	H.	Kanara . .	7·43	2·65	87·50	·82	1·60	86
131	Sirumanian, 28,667 .	H.	Madura . . .	7·42	1·12	89·29	·57	1·60	89
132	Jeera salai (Mosquith), 28,082.	H.	Kundapur, South Kanara.	7·37	·98	89·71	·63	1·31	88
133	Katari bhog, 26,767 .	H.	Naogaon, Rajshahi	7·37	·25	91·65	·22	·51	73
134	Dodagen kirsali bhatta, 29,416.	H.	Sampgaon . .	7·36	2·91	87·23	·83	1·67	86
135	... 28,450 .	H.	Grown in the Nara valleys of the Thar and Parkar District, Sind.	7·23	3·29	86·58	1·40	1·50	85

Arranged according to the percentage, on dry weight, of albuminoids found in the various rices.—concld.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.	Page.
136	Jhinjhin, 25,752 .	H. atap	Suket . . .	7·20	·72	90·81	·46	·81	83
137	Sadharam pandhara, 29,447.	H.	Chikodi . .	7·19	3·11	87·52	·7	1·44	86
138	Ladi, 28,073 . .	H.	Coimbatore, imported from Tenali.	7·15	·76	89·80	·70	1·53	88
139	Baytee (Desi), 26,407 .	H.	Chittagong .	7·14	·94	90·52	·56	·84	73
140	Hansraj, 25,745 . .	H.	Suket . . .	7·14	·48	91·12	·46	·80	83
141	Burmalgi, 29,458. .	H.	Kanara. . .	7·12	2·92	87·37	·89	1·70	86
142	Halga, 29,449 . .	H.	Ditto . . .	7·09	2·61	88·21	·88	1·21	86
143	Mungi, 25,955 . .	H.	Birampur . .	7·00	·32	91·16	·78	·74	71
144	Sittisal, 25,471 . .	H.	Rajahat . .	7·00	·32	91·39	·34	·95	70
145	Chini shakkar, 25,465 .	H.	Abdalpur . .	7·00	·11	91·89	·49	·51	70
146	Budama, 28,680 . .	H.	Nandyal . .	6·96	1·75	89·60	·61	1·08	89
147	Geri, 25,981 . .	H.	Cuttack . .	6·93	·38	91·08	·38	1·23	77
148	Banathikai, 28,083 .	M.	Kundapur, South Kanara.	6·88	1·14	90·35	·59	1·04	88
149	Chila kat, 28,085 .	M.	Raipur . . .	6·88	·77	91·06	·46	·83	78
150	Kusumakulu, 28,075 .	H.	Coimbatore, imported from Tenali.	6·88	·79	90·85	·44	1·04	88
151	Kubri mohar, 28,084 .	M.	Raipur. . .	6·87	·99	90·54	·44	1·16	78
152	Hansa, 28,088 . .	M.	Ditto . . .	6·87	·92	90·77	·40	1·04	78
153	Bhejri, 28,087 . .	M.	Ditto . . .	6·84	·97	90·75	·44	1·00	78
154	Lajuk badan, 25,976 .	H. atap	Cuttack . .	6·58	32	92·22	·20	·68	77
155	Gowri sanna biyyam, 28,681.	H.	Bellary . .	6·50	1·24	90·36	·77	1·13	89
156	Manjamolasi or Kembath, 28,690.	H.	Kollegal . .	6·49	1·28	90·20	·56	1·47	89
157	Dadkhani, 25,467	H.	Haripur or Dinajpur.	6·46	·11	91·93	·48	1·02	70
158	Mach kanta, 25,979	H. atap	Cuttack . .	6·31	·54	91·69	·34	1·12	77
159	Motsafa, 25,989 . .	H.	Ditto . . .	6·06	·25	92·18	·40	1·11	77

TABLE III.

Arranged according to the percentage, on dry weight, of fat found in the variou rices.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Fat.	Albuminoids.	Carbohydrates.	Fibre.	Ash.	Page
1	Kamod, 29,337 . .	H.	Dhulia . .	3·56	11·36	82·17	·93	1·98	85
2	Badarphui or Badshapasand, 30,665.	H.	Rai Bareli . .	3·54	8·28	85·35	1·05	1·78	79
3	Bengalia, 28,860 . .	H.	Chikli, Surat .	3·45	10·48	83·13	1·07	1·87	85
4	Ambemohar (white), 29,444.	H.	Belgaum . .	3·39	9·73	84·45	·87	1·56	86
5	Dhundhani, 28,861 .	H.	Broach . .	3·36	11·35	82·32	1·06	1·91	85
6	Bhusalia, 28,865 . .	H.	Chikli, Surat .	3·35	9·44	84·69	·85	1·67	85
7	Lajura or Jillour, 30,657.	H.	Benares . .	3·31	8·39	85·42	1·14	1·74	79
8	... 28,450 .	H.	Grown in the Nara valleys of the Thar and Parkar District, Sind.	3·29	7·23	86·58	1·40	1·50	85
9	Kala jirga, 29,421 .	H.	Chandagad . .	3·29	9·32	84·78	·88	1·73	86
10	Lalka or Ram bhog, 30,649.	H.	Faizabad District	3·27	7·97	85·96	1·12	1·68	79
11	Karangi, 30,651 . .	H.	Benares . .	3·27	7·80	86·12	1·14	1·67	79
12	Kare ambemohar, 29,417.	H.	Sampgaon . .	3·26	8·89	84·86	·97	2·02	86
13	Harkeswa, 30,646 .	H.	Faizabad District	3·16	8·33	85·52	1·16	1·83	79
14	Sukhvel, 28,863 . .	H.	Broach . .	3·14	7·84	86·60	1·09	1·33	85
15	Kolam, 28,862 . .	H.	Chikli, Surat .	3·13	9·12	85·31	·88	1·56	85
16	Dodka sal, 29,122 .	H.	Dhulia . .	3·13	7·72	86·64	·85	1·66	85
17	Sadharam pandhara, 29,447.	H.	Chikodi . .	3·11	7·19	87·52	·74	1·44	86
18	Ambersal (small), 29,429.	H.	Khanapur . .	3·10	11·05	83·69	·83	1·33	86
19	Sufedka, 30,648 . .	H.	Faizabad District.	3·08	7·65	86·42	1·05	1·80	79
20	Gondawa, 30,664 . .	H.	Rai Bareli . .	3·08	7·89	86·20	1·11	1·72	79
21	Lalbagri, 30,658 . .	H.	Ditto . .	3·03	9·47	84·43	1·25	1·82	79
22	Kada, 28,866 . .	H.	Chikli, Surat .	3·01	8·68	85·82	·93	1·56	85
23	Ratria (*i.e.*, inclined to red), 28,449.	H.	Lower Sind . .	3·01	8·48	85·55	1·18	1·78	85
24	Sanna bhatta kirsali, 29,4 9.	H.	Sampgaon . .	2·98	8·17	86·06	1·00	1·79	86

Arranged according to the percentage, on dry weight, of fat found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Fat.	Albuminoids.	Carbohydrates.	Fibre.	Ash.	Page.
25	Shanzira, 30,655 . .	H.	Benares . .	2·94	8·37	85·91	·97	1·81	79
26	Burmalgi, 29,458 .	H.	Kanara . .	2·92	7·12	87·37	·89	1·70	86
27	Sali bhatta, 29,412 .	H.	Sampgaon . .	2·92	8·19	86·33	·88	1·68	86
28	Dodagen kirsali bhatta, 29,416.	H.	Ditto . .	2·91	7·36	87·23	·83	1·67	86
29	Kada, 28,864 . .	H.	Olpad, Surat .	2·89	7·89	86·47	1·07	1·68	85
30	Ambon, 26,384 . .	H.	Kyauktaw, Akyab District.	2·89	8·89	85·38	1·25	1·59	75
31	Monghi salia, 28,867 .	H.	Bardoli, Surat .	2·85	9·04	85·82	·85	1·44	85
32	Dehula, 30,661 . .	H.	Rai Bareli . .	2·82	8·46	86·08	1·20	1·44	79
33	Madhali atsal, 29,432 .	H.	Belgaum . .	2·81	8·65	86·15	·83	1·56	86
34	Dodaga, 29,451 . .	H.	Chandagad . .	2·77	9·22	85·93	·76	1·32	86
35	Jadi sal, 29,121 . .	H.	Dhulia . . .	2·75	8·09	86·28	·87	2·01	85
36	Dhana sal, 29,123 .	H.	Ditto . .	2·75	8·36	86·36	·87	1·66	85
37	Matian (*viz.*, pearly), 28,447.	H.	Lower Sind . .	2·72	8·14	85·54	1·20	2·40	85
38	Somasal, 29,461 . .	H.	Kanara . .	2·65	7·43	87·50	·82	1·60	86
39	Halga, 29,449 . .	H.	Ditto . .	2·61	7·09	88·21	·88	1·21	86
40	Hukeri rice No. 1, 29,453.	H.	Hukeri . .	2·59	7·81	87·36	·71	1·53	86
41	Gunga, 28,448 . .	H.	Lower Sind . .	2·18	7·80	86·89	1·18	1·95	85
42	Hakua, 28,048 . .	H.	Khatmandu . .	2·11	9·61	85·71	·83	1·74	81
43	... 26,408 . .	H.	Krin-Chaung, Northern Arakan.	1·80	9·33	86·75	1·05	1·07	75
44	Budama, 28,680 . .	H.	Nandyal . .	1·75	6·96	89·60	·61	1·08	89
45	Pasha pasandu, 28,671.	H.	Ditto . .	1·56	8·80	88·14	·48	1·02	89
46	Nakenjee, 26,287. .	M.	Kyauktaw, Akyab	1·50	7·93	88·98	·68	·91	75
47	Chini kapur, 28,089 .	M.	Raipur . .	1·44	7·99	88·89	·48	1·20	78
48	Kadiri biyyam, 28,674.	H.	Nandyal . .	1·41	8·85	87·98	·47	1·29	89
49	Nagra, 26,075 . .	H.	Bardwan . .	1·38	8·43	88·03	·92	1·24	71
50	Yella dapu biyyam, 28,678.	H. atap	Nandyal . .	1·35	7·62	89·47	·54	1·02	89
51	Horuchikan (new), 26,398.	H.	Buthidaung, Akyab District.	1·28	8·28	88·83	·83	·78	75

Arranged according to the percentage, on dry weight, of fat found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Fat.	Albuminoids.	Carbohydrates.	Fibre.	Ash.	Page.
52	Manja molasi or Kembath, 28,690.	H.	Kollegal . .	1·28	6·49	90·20	·56	1·47	89
53	Dudhi saru, 28,029 .	H.	Raxaul, Champaran.	1·27	8·65	87·37	·65	2·06	81
54	Gowri sanna biyyam, 28,681.	H.	Bellary . .	1·24	6·50	90·36	·77	1·13	89
55	Rato marsi, 28,035 .	H.	Khatmandu . .	1·15	7·66	89·92	·31	·96	81
56	Banathikai, 28,083 .	M.	Kundapur, South Kanara.	1·14	6·88	90·35	·59	1·04	88
57	Sirumanian, 28,667 .	H.	Madura . .	1·12	7·42	89·29	·57	1·60	89
58	Khayan chain, 26,389 .	M.	Kyauktaw, Akyab	1·08	8·12	89·84	·45	·51	75
59	Sonamukhi, 26,406 .	H.	Chittagong . .	1·06	9·52	87·92	·49	1·01	73
60	Jara marsi, 28,041 .	H. atap	Khatmandu . .	1·02	7·55	90·23	·29	·91	81
61	Samjira, 28,036 . .	H.	Ditto . .	1·00	8·77	88·90	·31	1·02	81
62	Kubri mohar, 28,084 .	M.	Raipur . .	·99	6·87	90·54	·44	1·16	78
63	Jeera salai (Mosquith), 28,082.	H.	Kundapur, South Kanara.	·98	7·37	89·71	·63	1·31	88
64	Boka or komal, 26,687	H.	Tezpur . .	·98	8·01	88·45	·91	1·65	73
65	Bhejri, 28,087 . .	M.	Raipur . .	·97	6·84	90.75	·44	1·00	78
66	Touli, 28,044 . .	H. stap	Khatmandu . .	·95	8·85	88·97	·32	·91	81
67	Baytee (Desi), 26,407 .	H. atap	Chittagong . .	·94	7·14	90·52	·56	·84	73
68	Gurmatia, 28,086 . .	M.	Raipur . .	·93	8·02	89·51	·60	·94	78
69	Sanna akki, 28,081 .	M.	Kundapur, South Kanara.	·92	8·01	89·70	·44	·93	88
70	Hansa, 28,088 . .	M.	Raipur . .	·92	6·87	90·77	·40	1·04	78
71	Manikimadhuri or Kunkunia jaha, 26,690.	H.	Tezpur. . .	·88	9·19	88·52	·50	·91	73
72	Kamini, 25,463 . .	H.	Rangamatti . .	·85	8·45	89·34	·40	·96	70
73	Bili sepoy, 28,684 .	H.	Bellary. . .	·84	7·46	90·10	·75	·85	89
74	Chaba, 28,047 . .	H.	Khatmandu . .	·83	8·24	89·76	·38	·79	81
75	Mattainarayan, 28,670	H.	Madura . .	·82	7·80	89·92	·38	1·08	89
76	Balthi akki, 28,079 .	M.	Kasaragod, South Kanara.	·81	8·38	89·74	·35	·72	88
77	Ghunchi, 25,624 . .	M.	Khulna . .	·81	10·09	87·61	·64	·85	70

Arranged according to the percentage, on dry weight, of fat found in the various rices.—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Fat.	Albuminoids.	Carbohydrates.	Fibre.	Ash.	Page.
78	Chhilait atab, 25,472 .	H. atap	Rajahat . .	·81	9·92	87·86	·51	·90	70
79	Molakola kulu, 28,074 .	M.	Coimbatore, imported from Tenali.	·80	7·72	89·87	·51	1·10	88
80	Kusuma kulu, 28,075 .	H.	Ditto .	·79	6·88	90·85	·44	04	88
81	Gulab sooroo, 25,461 .	H.	Rangamatti . .	79	8·44	89·07	·68	1·02	70
82	Swarnavarimatta samba, 28,077.	H.	Coimbatore, imported from Palghat.	·79	8·50	86·54	·55	3·62	88
83	Gouria, 28,038 . .	H.	Khatmandu . .	·77	8·29	89·71	·32	·91	81
84	Fooren, 26,749 . .	M.	Manipur . .	·77	9·38	88·53	·47	·85	73
85	Chila kat, 28,085 . .	M.	Raipur. . .	·77	6·88	91·06	·46	·83	78
86	Basful, 28,030 . .	H.	Raxaul, Champaran.	·77	7·58	90·39	·31	·95	81
87	Ladi, 28,073 . .	H.	Coimbatore, imported from Tenali.	·76	7·15	89·80	·76	1·53	88
88	Baya hunda, 28,686 .	H.	Berhampur, Ganjam	·75	8·13	89·53	·68	·91	89
89	Pati dhan, 26,063 .	H. atap	Goalpara . .	·75	8·52	89·32	·73	·68	73
90	Dudhya motal, 25,625 .	M.	Khulna. . .	·74	9·33	88·47	·67	·79	70
91	Sambavulu, 28,679 .	H.	Nandyal . .	·73	8·93	89·18	·36	·80	89
92	Jhinjhin, 25,752 . .	H. atap	Suket . . .	·72	7·20	90·81	·46	·81	83
93	Baradhan, 26,689 .	M.	Tezpur . .	·71	9·66	88·05	·61	·97	73
94	Laxmi bhog, 28,090 .	M.	Raipur. . .	·70	7·92	90·01	·44	·93	78
95	Basmati, 28,037 . .	H.	Khatmandu . .	·70	8·25	90·07	·25	·73	81
96	Rangooni chal, 25,626 .	H. atap	Rangoon . .	·70	8·43	89·70	·38	·79	75
97	Ujla, 25,748. . .	H. atap	Sirmur. . .	·69	8·00	89·76	·57	·98	83
98	Kasiatu, 25,747 . .	H.	Arki and Bilaspur.	·68	7·83	89·62	·91	·96	83
99	Chanti, 25,956 . .	H.	Phulbari . .	·68	7·62	89·57	·76	1·37	71
100	Sirumani, 28,076 . .	H.	Coimbatore, imported from Tenali.	·66	7·52	89·98	·42	1·42	88
101	Rajimani, 26,649 . .	H.	Futalla, Bogra .	·65	7·47	90·17	·81	·90	73
102	Krishen bhog, 28,046 .	H.	Khatmandu . .	·64	8·89	89·41	·27	·79	81

Arranged according to the percentage, on dry weight, of fat found in the various rices—contd.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Fat.	Albuminoids.	Carbohydrates.	Fibre.	Ash.	Page.
103	Jeera salai, 28,080 .	M.	Kasaragod, South Kanara.	·64	·42	88·51	·33	1·10	88
104	Gonda salai, 28,078 .	M.	Ditto .	·64	9·00	88·60	·44	1·3	88
105	Samudrafin, 28,039 .	H.	Khatmandu . .	·63	9·94	88·37	·27	·79	81
106	Patna table rice, 26,208	H.	Calcutta market .	·59	8·08	90·37	·27	·69	71
107	Bardhana, 26,062 .	H. atap	Rangoon . .	·56	8·51	89·87	·50	·56	75
108	Balessari, 28,031 .	H.	Raxaul, Champaran.	·56	7·66	90·69	·25	·84	81
109	Kumbi, 26,754 . .	M.	Manipur . .	·54	8·61	89·72	·45	·68	73
110	Mach kanta, 25,979 .	H. atap	Cuttack . .	·54	6 31	91·69	·34	1·12	77
111	Aus, 26,058 . .	H.	Chandpur . .	·53	9·16	88·57	·85	·89	73
112	Bardhana, 26,061 .	H.	Goalpara . .	·51	9·11	88·45	·87	1·06	73
113	... 31,310 .	M.	Rangoon . .	·49	8 63	89·65	·50	·73	75
114	Kauk-nyin, 21,761 .	H.	Pegu . . .	·48	9·24	89·05	·26	·97	75
115	Sirmaoribegmi, 25,755.	M.	Sirmur . .	·48	7·49	90·43	·73	·87	83
116	Hansraj, 25,745 . .	H.	Suket . . .	·48	7·14	91·12	·46	·80	83
117	Bogra, 25,743 . .	H.	Sirmur . .	·46	7·55	90·45	·51	1·00	83
118	Mach kanta, 25,985 .	H.	Cuttack . .	·45	7·50	90·20	·56	1·29	77
119	Shiti patanai, 25,462 .	H.	Mundra Bazar .	·45	8·86	8 ·43	·58	·68	70
120	Nagra, 26,074 . .	H. atap	Bardwan . .	·43	8·92	89·59	·43	·63	71
121	Tira, 25,744 . .	H.	Kangra . .	·43	7·66	90·27	·61	1·03	83
122	Lall bogra, 25,954 .	H.	Bhagalpur . .	·41	9·44	88·03	·87	1·25	71
123	Aus chal or bitri chal, 26,053.	H.	Dhubri . .	·40	8·88	88·70	·91	1·11	73
124	Chhata balam, 25,464 .	H.	Neragirza, Calcutta	·40	9·52	88·89	·24	·95	70
125	Geri, 25,981 . .	H.	Cuttack . .	·38	6·93	91·08	·38	1·23	77
126	Basumati, 25,983 .	M.	Ditto . .	·38	8·11	90·06	·43	1·02	77
127	Kamal bhog, 25,469 .	H.	Rajahat . .	·38	8·44	89·90	·55	·73	70
128	Katari bhog, 25,960 .	H.	Dinajpur . .	·37	7·53	90·60	·53	·97	71
129	Kapur kanta, 25,986 .	H.	Cuttack . .	·35	8·13	89·53	·55	1·44	77
130	Kalan, 25,749 . .	H.	Sirmur . .	·34	8·40	90·21	·25	·80	83
131	Handa, 25,975 . .	H.	Cuttack . .	·34	7·53	90·40	·38	1·35	77

Arranged according to the percentage, on dry weight, of fat found in the various rices—concld.

Ordinal No.	Name and Registration No.	Milled or Husked.	Origin.	Fat.	Albuminiods.	Carbohydrates.	Fibre.	Ash.	Page.
132	Rhiand, 25,750	H.	Suket	·34	9·30	89·00	·56	·80	83
133	Lajuk badan, 25,976	H. atap	Cuttack	·32	6·58	92·22	·20	·68	77
134	Sittisal, 25,471	H.	Rajahat	·32	7·00	91·39	·34	·95	70
135	Mungi, 25,955	H.	Birampur	·32	7·00	91·16	·78	·74	71
136	Kalojira, 26,049	H. atap	Mymensingh	·31	9·31	88·91	·69	·78	73
137	Patna table rice, 26,206	H.	Calcutta market	·30	7·66	90·92	·55	·57	71
138	Ramjamani, 25,756	H.	... Punjab	·30	8·47	89·91	·39	·93	83
139	Nanhia, 25,959	H.	Dinajpur	·27	7·48	90·57	·53	1·15	71
140	Old Land Patna rice, 26,207.	H.	Calcutta market	·27	8·66	90·21	·23	·63	71
141	Nga-sein, 21,760	H.	Pegu	·27	7·88	90·39	·60	·86	75
142	Katari bhog, 26,767	H.	Naogaon, Rajshahi	·25	7·37	91·65	·22	·51	73
143	Motsafa, 25,989	H.	Cuttack	·25	6·06	92·18	·40	1·11	77
144	Nal tukri, 25,993	H.	Ditto	·25	7·54	90·46	·40	1·35	77
145	Rhinjri, 25,751	H.	Andur, Bilaspur	·25	8·21	90·37	·37	·80	83
146	Lajuk badan, 25,978	M.	Cuttack	·25	8·54	89·74	·34	1·13	77
147	Rice for mudi, 25,987.	H.	Ditto	·23	8·09	90·38	·29	1·01	77
148	Sukhdas, 25,753	H.	Palampur	·23	8·16	90·34	·53	·74	83
149	Katari bhog, 25,957	H.	Bhagalpur	·23	8·34	90·14	·43	·86	71
150	Manmohini, 25,470	H.	Fatehpur	·22	8·61	90·29	·27	·61	70
151	Basumati, 25,754	H.	Amritsar	·21	7·85	91·00	·25	·69	83
152	Chokha chanti, 25,958	H.	Gaya	·21	7·95	90·67	·31	·86	71
153	Bansmati, 25,746	M.	... Punjab	·21	8·87	89·81	·25	·86	83
154	Aman, 26,059	H.	Chandpur	·18	7·65	89·92	·85	1·40	73
155	Roopsal, 25,466	H.	Rajahat	·18	7·78	90·57	·68	·79	70
156	Bank tulsi, 25,468	H.	Abdalpur	·13	8·40	90·35	·39	·73	70
157	Chini shakkar, 25,465	H.	Ditto	·11	7·00	91·89	·49	·51	70
158	Bank tulsi, 26,052	H.	Mymensingh	·11	9·18	89·68	·47	·56	73
159	Dadkhani, 25,467	H.	Haripur or Dinajpur.	·11	6·46	91·93	·48	1·02	70

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INDIAN PENS.

Indian Pens, their history, classification, materials used and methods of manufacture. *By* I. H. BURKILL.

INTRODUCTORY.

It is necessary before discussing native pens to enumerate the materials on which they are or were required to write.

Materials for writing on.

First of all there is the palm leaf; and the ways of writing on it are two, (*i*) by incision with a point with or without rubbing in ink afterwards, and (*ii*) by application of ink to the unbroken surface; secondly, there is paper with its various degrees of finish; and thirdly, the dust-board: the fourth and fifth of writing materials are now out of use; they were birch-bark and heavily sized cotton. The parchment and papyrus of the Mediterranean region do not seem to have been used in India.

Palm-leaf books were the only books of the south until comparatively recent times; birch-bark was the old writing material of the north, heavily sized woven cotton cloth seems to have been used in various places for special purposes: paper came in with the Mughals except into Burma and perhaps into Nepal and the dust-board is the simple calculator of everywhere—a board covered with dust on which the writing or calculation is done, and then soon rubbed out again.

The Musalmans spread paper-making through the Old World.

Paper-making is recorded as an invention of the Chinese in perhaps the second century of the Christian era. Chinese prisoners of war in 751 A.D. introduced its use among the Arabs: they made it in Samarkand, which the Arabs had captured in 704 A.D.: and up to the 11th century that city remained famous for its paper. Bagdad from 794 A.D. onwards stood second to Samarkand as a paper-making centre, and kept its industry up to the 14th century. Damascus became famous for its paper in the 10th century. In the 11th century Cairo came to be known for its paper. Paper-

INTRODUCTORY.

making, after the Chinese had taught the Arabs how to make it, became a notable Muhammadan industry; in spreading its manufacture they have done a vast work in the world: they introduced it into Spain and had good factories there, better than those of the Christians who followed them: they probably introduced it into Sicily: theirs was the paper introduced into Greece. By their efforts paper-making thus entered Europe and displaced the papyrus and the skin-parchments of the ancients.

It is clearly evident that excluding Nepal and Burma the Musalmans introduced paper-making into India as into Europe.

In Akbar's reign its manufacture was commenced in Kashmir and it was encouraged under his successors there and elsewhere, as well as under the Peshwás and other rulers who came into power as the Mughal Empire broke up. Thus it happened that down the western side of India paper became the chief of writing materials, and then its use spread eastwards. Into Burma its use has undoubtedly come direct from China.

It is important to note now that the art of paper-making long before its introduction into India had advanced far enough for the paper to be sized and made smooth. Wiesner has examined many old Asiatic papers and recorded his observations in an essay entitled Mikroskopische Untersuchung alter ostturkestanischer und anderer Asiatischer papiere (Denkschriften Akad. Wien, Mathem-naturw. Cl. LXXII, pp. 583-632): he found that by the 7th century in Turkestan the use had come in of plaster of Paris together with a gelatine made from lichens or of starch-paste.

We need in India to examine some of our oldest preserved papers in order to ascertain their relation to those made north of the Himalaya.

CLASSIFICATION OF PENS.

The pens used by Indians for writing on these various materials fall into six classes:—

(1) the iron style,
(2) the porcupine quill,
(3) the bamboo pen,
(4) the palm mid-rib pen,
(5) the reed and fern pens, and
(6) the quill.

The Chinese domiciled in Calcutta write with their indigenous brush.

The iron style is used only for writing on (incising) palm leaves. The porcupine quill is only used for making calculations

on a dust-board. These two never have slit points for carrying ink and giving flexibility: the other three classes of pen have slit points after the fashion of the European pen, and are flexible. We thus get two very distinct types of pens and the use of both goes back further than history. The one was the Stylus or στῦλος and the other the Arundo or Calamus (κάλαμος) of the Romans and Greeks. The last is the real precursor of the modern pen. CLASSIFICATIONS OF PENS.

The stylus or lekhani of India consists of an iron bodkin often with the upper end weighted by flattening or otherwise, that it may, when it is not actually being pressed down, fall towards the back of the hand of its own accord, raising the point from the surface being incised. THE IRON STYLE.

The Indian Museum possesses a long series of these iron styles, the old specimens all from Orissa, but the new ones chiefly a recent and most excellent gift from the Government of Madras. The simplest form might be considered an imitation in iron of the porcupine's quill: it is an iron rod like a stout knitting needle variously sharp at one end or at times at both. Such styles have all come from the contiguous districts of Vizagapatam, Godaveri, Kurnool, Kistna and Nellore. Shorter, but otherwise similar, rods have come from Godaveri. Short and doubly sharp rods have come from Ganjam and Vizagapatam only. The now generally disused style of Burma, of which Mr. Mackenna, after much trouble kindly taken, has only been able to get me a single specimen, is short like those of Ganjam, but not so sharp though more tapering. Styles of a much heavier type, doubly sharp and very thick in the middle, have been received from the opposite coast of India—from the contiguous districts of South Kanara and Malabar. Styles of a third type are thick and weighted towards one end—the upper end: they have been in use, I believe, in every district of India south of the Godaveri. The weighting is achieved in simple cases by a mere gradual thickening of the stem towards the upper end: but in more elaborate pens we find it achieved by means of a little abrupt globe placed upon the stem just above the middle: styles of this class are in many cases beautifully ornamented with bidri work. They have been received from the districts of Malabar and South Kanara and from the town of Anjengo which stands cut off from Malabar by a strip of Travancore territory; and further one specimen has come from the opposite coast—from Nellore. Similar to the last but brass-topped are styles from the contiguous districts of Kistna and Nellore, and the somewhat remote district of Madura. It is not unnatural that costly pens such as these

THE IRON STYLE.

should travel about the country and so get a dispersal which the ordinary pen does not.

The rest of the types of style consists of a combination of a knife, for cutting the palm leaf, and a point for writing on it. The simplest forms have the upper end of the rod flattened into a blade and sharpened. Out of type 1 above, is thus evolved a style which we may call type four, and out of type 3 type five: types four and five are used in the same parts of India as types one and three respectively, *i.e.*, in the same or contiguous districts: type four is therefore eastern, and type five western and southern. Type four develops in Orissa and Ganjam into a very characteristic form—a style with a broad flat head, one edge of which facing down is for cutting the palm leaf, while towards the other side is an eye-hole for suspending the pen. The Indian Museum possesses a long series of styles of this type. One curious style from Cuddapah has two cutting edges and two eye-holes: others from Anantapur and Kurnool have the two eye-holes but only one cutting edge.

As type six is the clasp-knife, against one side of a wooden or iron handle folds the style, and against the other the knife blade. The wood of the handle is often ebony: the blade sometimes possesses a notch near the apex to enable the thumb to open it; and sometimes a brass stamp for a seal is affixed. This clasp-knife type has been received from almost all of the districts south of Madras. Two kindred types remain to be named, of each of which I have but one specimen. Type seven may be regarded as type four provided at the middle with a wooden sheath which can be folded over the blade or over the style-point, and type eight is an European two-bladed clasp-knife turned into a style by the filing down of one blade. Type seven came from Malabar, and type eight from Salem.

Lastly there is the two-pronged style for describing circles and parallel lines; it is alike at both ends and with a twisted column. Of it specimens have come to me from Salem, South Arcot and Madura.

The style or Ka-nyit of Burma is pointed at both ends. Monks use it still in some small degree. It is no more than a simple rod of iron, both ends of which can be used for writing.

Ink is by no means always used with these styles, and even if used is not carried to the palm leaf by the style, but spread over the surface afterwards, whereupon the broken surface takes it up.

THE IRON STYLE.

It appears probable that the style was the pen used invariably in the extreme south of India before the Portuguese reached the east; and palm leaf-books were there the only books used. With the Portuguese came the use of the quill and the adoption in Tamil of the word 'penna' for an ink-carrying pen.

THE PORCUPINE QUILL.

The porcupine quill needs no manufacture for use. We have in British India four species of porcupine two of which **Hystrix leucura** and **H. bengalensis** have on the flanks between the crest and the tail the straight spines which serve as pens: these spines are few in **H. bengalensis,** and perhaps are very little used. The common porcupine quill of the bazaar of India is the quill of **H. leucura.** The flesh of a porcupine is clean and eaten; but "throw the quills away lest they breed strife," says a Mysore proverb, in allusion to their use for writing.

THE BAMBOO PEN.

Leaving classes 1 and 2 with which we are not very immediately here concerned we proceed to the true pens. The bamboo pen is not so flexible as the reed pen and not well suited for writing curves: the result is that the bamboo is more used in those parts of India where the characters are stiff than in those where they are curved or is avoided for cursive forms of the stiffer scripts. Thus it happens that children are taught to form their letters with the bamboo and thereafter allowed to learn to write a cursive hand with the reed pen. They will write अ क ख ग with the bamboo, but ಅ ಕ ಖ ಗ with the reed.

Ornamented bamboo pens are more abundantly sold in Western and Southern India than in Eastern India. They are said to be prepared in China entering India by Bombay and Karachi. Whether Chinese or not they certainly pass through Singapur from somewhere beyond. The bamboos used for them are obviously selected for the length and straightness of the internodes between their joints.

Imported ? Chinese bamboo pen.

I recognise that two species of bamboo furnish them; for of the pens one is grey-green and has been in all cases ornamented with oval spots while the other is chestnut-brown ornamented with cloudy blotches or lines of dots. My specimens of the first have been bought in the bazaars of Madras, Bombay, Nágpur and Delhi; while my specimens of the second have been bought in those of Madras, Hyderábád, Nágpur, Akot (Berár) and Narsingpur. It will be noticed at once that these pens find a fairly wide market. The first named pen seems to be sold with invariably one, sometimes two, nodes on the length, while the second generally has

THE BAMBOO PEN.

none. The second has a larger lumen than the first and is generally a little stouter.

I should say that they probably come from different places: the size and the way in which they have been treated suggests this.

I have further received from Nágpur a single pen dyed red (with eosin apparently) which seems to have come from the same kind of bamboo as the second of those just described. I assume that it is also of Chinese origin.

What bamboos are the sources of these pens I cannot say. There is no literature known to me.

Bamboo pens of Indian origin.

I now pass on to bamboo pens of Indian origin. I shall take them in two groups, (*i*) the solid pens made from strips of bamboo stems and (*ii*) the hollow pens, like the imported Chinese pens made of bamboo branches.

Bengal is the chief place where the bamboo pen is employed. Its use is customary with certain classes of people: astrologers (achcharyas) for instance use the bamboo-splint pen as a part of the ceremonial of casting horoscopes, and Hindu pandits affect it somewhat. School boys and ordinary country folk use the pen of a bamboo joint commonly called *Kanchi*, or as pronounced in Bengali *Konchi*. The use of both kinds of pens is, indeed, general among the Bengalis. The stems or branches required are cut green and often seasoned by being immersed in water or put into mud, for a fortnight or more. Exactly what process this seasoning implies has not been worked out, but the pen is said to be harder, *i.e.*, to keep its point better from it: and indeed bamboos for other purposes are seasoned by immersion in water. Bamboos after immersion are said to be less subject to insect attacks than if not immersed, because the water has withdrawn the sap from them; but bamboo pens would hardly be liable to insect attacks and the seasoning in water would seem to have the other use of hardening them.

Beyond the confines of Bengal the use of bamboo-splint pens extends. I have received them from the Nepál hills, Yeotmál in the Central Provinces and South Kánara. In Bengal the strips of bamboo are often shaped carefully to be thickest where the fingers grip, and to taper to the upper end. My samples from Yeotmál and South Kánara show none of this: they are indeed crude. To make the point, the inner part of the bamboo is cut away and the point itself is split as is a quill. The actual writing is thus done with the outer part of the wood which is the hardest. The bamboo

THE BAMBOO PEN.

used is probably in most instances from one of the more common species of *Bambusa*.

The bamboo branches which serve in Bengal do not possess long internodes like those of the ornamented imported pens described first, and the pens are of necessity only about five to six inches long. The lumen is small and without being artificially enlarged hardly comes near enough to the point, when cut, to serve as a reservoir for ink. It seems possible that **Bambusa arundinacea** is the chief source of these pens; and, as it grows very generally throughout Bengal, the local demand is locally satisfied.

Bambusa vulgaris is probably also used: it—the Bariala bamboo—is said to be used in Chittagong.

Dendrocalamus strictus seems to be put under contribution at Chindwara in the Central Provinces.

Ochlandra Rheedii and **O. travancorica** are reported to me as used in Tinnevelli, and the former in Mysore.

What is certainly a species of **Arundinaria** is used for making pens in the Nágá hills. It has reached me under the name of *Jili bans* and is perhaps **Arundinaria Prainii.**

A pen with a large lumen from Multán is, I suspect, from **Dendrocalamus strictus.**

Another **Arundinaria** which furnishes pens about Darjeeling is **A. racemosa,** locally called *Malingo;* but is apparently only one of three bamboos there put under contribution. A second received under the vernacular name of *Khapteri* is a bamboo of the lower hills of Sikkim which I cannot name. *Deo Nigali* is the third, and is also an **Arundinaria.** *Nigala* is said by Gamble to be a name of **A. intermedia,** *Munro;* but *Deo Nigali* is an **Arundinaria** of greater elevation. I have made an attempt to collect *Deo Nigali* in the Darjeeling District but without success, though I looked for it all along the Singlela ridge up to 12,000 feet, and elsewhere at lower elevations.

I found to be sold in Khátmándu a very hard little bamboo pen with a small lumen: its origin I cannot determine.

PALM MID-RIB PENS.

We leave bamboo pens and proceed to palm mid-rib pens.

These are inferior to the bamboo in serviceableness: they are made from the mid-rib of the sago palm **(Caryota urens)** in Southern India. I have received specimens from Anantápur and South Kánara in Madras and from Poona in Bombay. It is reported to me by Mr. G. A. Gammie that they are used in the Haveri Taluka of the Dhárwár District. Bagani galaga or simply Bagani is the name

PALM MID-RIB PEN.

given to them about Anantápur, Dhárwár. From some of the pens the epidermis has been scraped; on others it has been left. The point is made from the outer tissues on the ventral—rounded—side of the mid-rib.

REED PEN.

Of the reeds many species are used. In my collection I have reed-pens derived from:—

- **Hollow.**
  - **Saccharum fuscum.**
  - **Phragmites Karka.**
  - **Phragmites communis.**
  - **Arundo Donax.**
  - **Triraphis madagascariensis.**
- **Solid.**
  - **Saccharum arundinaceum.**
  - **Saccharum spontaneum.**
  - **Sorghum halepense.**
  - **Sorghum vulgare.**
  - **Pennisetum typhoideum.**

Saccharum fuscum.

Out of all the reeds **Saccharum fuscum,** noteworthy in its genus for its hollow stem, is apparently that which makes the best of reed-pens. The grass is reported to grow at Disful in Persia plentifully and the pens are thence imported into India by Bombay. It also grows in wet places in Eastern Bengal, and receives some small degree of cultivation; that is to say, it may be purposely planted and protected until it has grown up, when the stem is cut, with the leaves and the leaf-sheaths stripped off; and it is sold in lengths of several feet or cut into lengths of one or two internodes. It grows also, and is used for pen-making on the banks of the Godávari and Kistna in the Madras Presidency: and to some extent it is collected locally in the Circárs. It is reported in various places that the Nepál Terái furnishes some of the pens, but at any rate it does not furnish many. One may know the reed by its deep brown colour, which, where the sun has not touched it, shades off to a dull straw colour. To ornament these pens before sale is unusual, but is sometimes practised by twining threads round them in spirals and then scorching them.

Such pens have been received only from the Central Provinces and Saháranpur.

Rarely, nature by means of some climber makes similar marks up the growing reed, the creeper preventing the sun from causing the stems to go brown.

Pens of this reed are extensively used all over the Bengals, through literate Assam, fairly generally through the peninsula of

India to the very south and westwards through the United Provinces to the Punjáb. They also reach Burma. Arabic and Persian characters are generally written with them; and Musalman immigrants have carried their use to the very south of India into a country where the Hindu population uses no such pen. They are also used for writing Nágari characters, particularly as stated above the more cursive forms. PALM MID-RIB PEN.

The reed is extensively named among the Bengalis Khag or Khagra, rarely Khagri, sometimes it is called Sar or Shar. A pen of Sar becomes Sar Katti or Sharkatti, or if the word 'Khagra' is used, Khagra Kalam.

Among the Hindi and Urdu speaking people we get the words Wasti, Owasti and Oasti with less common variants around, *e.g.*, Asthi (Monghyr), Osthir (Murshidábád), Owastir (Bánkurá), Ozastri (Midnapur), Wastir (Ghátál and Delhi, etc.). The use of Wasti extends into the Assam hills.

In Bombay, the Punjáb and the Central Provinces the general name is Kilak, a Persian word for a pen. In Patná and Muzaffarpur the name is also used in the form Killik; and the Chutia Nágpur, it is corrupted to Killi.

The word Wasti has been explained to me by a correspondent as derived from Wasit, a town in Persia. This name and the use of the Persian word Kilak, and in the Punjáb of the name Irani Kalam point to the origin of the pen and also suggest that its use in India is not ancient. It is said to be imported through Singapur also.

I now give two reports kindly obtained for me from Persia. In both reports one origin for the pens is given, *viz.*, Dizful. The connection of the pen with the town of Wasit has not been cleared up: it will be noticed that Major Ducat says that my supposition that Wasit is Gwasht is incorrect: there is, he says, no pen industry at Gwasht.

Note on the Cultivation and Produce of the Pen Reed (Qalam) in the Dizful District, by Captain D. L. R. Lorimer, His Majesty's Consul at Ahwaz, dated 14th March 1909.

The site of cultivation is the low lying ground along the course of the Diz river extending for some miles from a point three or four miles below the town of Dizful. The soil must consist solely of mud without any admixture of sand or gravel. Mode of cultivation.

Mode of cultivation.

The ground is prepared by a rough ploughing or hoeing and the preparation of water channels at short intervals. The channels are about $1\frac{1}{2}'$ deep and must always contain water.

REED PEN.

When the ground has been thus prepared roots (risha) of the reed are then planted out, and are left to grow and mature for three years. After these three years they are transplanted to similarly prepared ground. Thereafter they begin to yield reeds of commercial value as follows:—

In the 1st year *nil.*
In the 2nd year reeds suitable only for the Persian market.
In the 3rd year reeds suitable for the Persian market and a small quantity for export.
In the 4th year reeds suitable for Indian market.
In the 5th year ditto.
In the 6th year ditto.
In the 7th year reeds suitable for Indian market, and other foreign markets.

The produce of the 7th year is better in quality than that of any other year. The full life of the reed is said to be 16 years.

Preparation for the market.

When ready for cutting the reeds are stripped of all green leaves and sheaths. Their colour is then "white," which changes to the characteristic chocolate colour by exposure.

When this change has taken place they are cut and placed in store rooms from which fresh air is carefully excluded. Here they are allowed to dry and "sweat" for 40 days, after which they are taken out, graded, and disposed of.

Commercial differentiations of the reed.

The following types or qualities, all being obtained from the same plant, are recognised:—

1st Quality.—Qalam-i-Banyani, especially in demand in the Indian market.

These are thick well-developed reeds, well consolidated, and with long internodes (*qab*).

The local average price is Krans 4 per *dastah* of 100 (entire) reeds.

2nd Quality.—Qalam-i-Ablaq, a reed of inferior quality to the Banyani. It is described as more "sust," *i.e.*, slack, or less well consolidated. It is both exported and used locally, but is not in favour with Persians.

Average local price Krans 2 per *dastah.*

3rd Quality and 4th Quality.—Qalam-i-Amiri and Qalam-i-Mirzai. These are thinner than the preceding types,

but are well formed and are those in general demand in Persia where they are preferred to others. The two kinds vary apparently only in dimensions, the "Amiri" being slightly larger than the "Mirzai." REED PEN.

Prices vary much, but the average price is given as 1 to 1½ Krans per *dastah*.

These kinds are referred to from a commercial point of view as "Bab-i-Iran," the Banyani being "Bab-i-Hind." Trade and export.

The reeds vary in length from about six or seven feet to about 4 feet, in the case of some of the "Mirzai."

It is denied that in this district the reeds are cut before reaching maturity.

The value of reeds produced in the Dizful district is said to be liable to extreme fluctuation, the annual value varying between 5,000 and 100,000 Krans (the ordinary range of the value of the Kran being from 340 to 380 Krans per Rs. 100 = £6 13*s*. 4*d*.).

Within Persia, Dizful furnishes reeds to Hamadan, Ispahan, Shiraz, and probably Bushire.

Export is principally to India and *viâ* Bombay to Egypt, Constantinople and China.

The pen reed is said to be also found at Badrai on the Turko-Pusht-i-Kuh Frontier, and at Qal'a Tul in the Bakhtiari country, but the quality is inferior.

The flower of the reed is said to be useless, and propagation is wholly by division and planting out of the root.

Specimens of the flower will be obtained if possible. Specimens of the "Ablaq," "Amiri" and "Mirzai" types of reeds are forwarded with this report. Owing to the disturbed state of the country all commercial intercourse with Dizful has for some time been cut off, and specimens of the "Banyani" reeds are not at the moment obtainable here.

No. 15—109, dated the 15th April 1909.

From—Major C. T. Ducat, His Britannic Majesty's Consul, Kerman,

To—Major P. Z. Cox, C.I.E., Political Resident in the Persian Gulf.

With reference to your endorsement No. 23/535, dated 28th February 1909, enclosing copy of Government of India's letter No. 244-E.A., of the 16th February 1909, with its enclosures, I have the honour to inform you that my information is that the chief source of "Kilk or Irani Qalam" which furnishes the native pens is a dense jungle of reeds in the vicinity of Disful between the

REED PEN.

provinces of Khusistan, Luristan and Bakhtiari whence a large supply is said to be obtained every year and exported to Persian and Indian ports.

Kerman itself receives its supply from Bunder Abbas and possesses no reed jungle in its own district. Nasrullah Khan has been to the place —Gwasht—mentioned by Mr. Burkill and says there was no reed marsh there or any industry such as he mentions.

With Mr. Lorimer's report Major P. L. Cox forwarded to me excellent specimens of the reeds. The diameters of the different kinds are found to be as follows:—

Baniani	·275—·350 in.
Ablak	·225—·275 „
Amiri	·225—·275 „
Mirzai	·175—·250 „

This pen despite the fact that ninety cer cent. of the specimens in the country are of exotic origin is that which is commonly worshipped at the feast of Sri Panchámi by the literate of Bengal. As many pens are bought or brought for worship as there are males in the family and he who earns his living by writing must abstain from using (making a servant of) his pens on the feast day.

In parts of Assam these pens are only on sale about the feast time, Calcutta being the centre from which they are procured. Calcutta is naturally the main distributing centre for the North-East of India, and Bhagalpur serves as a subsidiary distributing centre for Western Bengal. In Orissa pens are worshipped on other feasts besides Sri Panchámi, *e.g.*, Durgá Pujás and Ganesh Chaturthi. In North-Western India, Delhi is a great distributing centre, whence this and other pens travel to all parts: and Bombay, the port at which they mostly arrive, distributes them through the peninsula of India.

It is unfortunate that I have no absolute proof that **Saccharum fuscum** grows in Persia. It is not mentioned by Boissier in his great *Flora Orientalis* nor by any later writers: but I believe that my identification made without flowers is quite correct.

Saccharum spontaneum.

Next to **Saccharum fuscum** in wideness of its use among the species of that genus, comes **Saccharum spontaneum,** a very common reed of most parts of India. It is turned into pens all over the Bengals by villagers, and again in most parts of the United Provinces, in many parts of the Punjáb and somewhat in Southern India. Its inferiority is recognised and it is now rarely brought

into the market for pen-making, though used extensively for fence-making, and as a binder in making mud walls. Delhi is one of the very few places where the reeds appear in the bazaar cut for pens: they are cut in double lengths enough for two pens. For pen-making only the very best grown of the reeds of this species are suitable. REED PEN.

Bákarganj, Jessore, Faridpur and neighbouring districts would seem to be those where the pen is much used: school boys learning to write particularly use it. Up the Brahmaputra Valley and the Ganges Valley, the use is not infrequent, the pens being sought just as required. Pilibhít, Moradábád and Bareilly supply Delhi with the reeds that are there sold. Reeds are locally cut just as pens are wanted in Southern India.

Saccharum spontaneum does not make such a clean looking pen as either the last or the next: for its stem is a dirty straw colour often blotched with red.

It is solid in most cases: and when hollow the lumen is very small and irregular.

A glance at our Floras will show how variable this grass is in stature: thus Hooker (*Flora of British India*, VII., p. 119) and Prain (*Bengal Plants*, p. 1188) say that it varies between 5—20 feet high. No wonder then that the pens from it vary in size. I have specimens in diameter ·4 in. (10 millimetres) and others only ·16 in. (4 millimetres).

The very thin specimens come from Anantápur and South Kánara in the Madras Presidency. The little stems are harder than the larger ones and perhaps specially chosen, just as the little hard stems of **S. fuscum** are preferred in Persia.

Like **S. fuscum** this reed is very commonly called *Khagra, Khagar, Khagara* or *Khagari* in Bengal. The use of Khagari extends to Sibságar. Towards Western Bengal the name varies to *Karia* (Rámpur Beauleah), *Kharai* (Rájmehál), *Khari* (Monghyr), and *Keshi* (Pakur), and *Keshia* (Bardwán). In North-Western Bengal the name *Kanda* is applied to it as to **Saccharum arundinaceum** and *Ikri* or *Inkri* is not uncommonly used in Tirhut.

Darbha, Darbe and *Dherbai* are the names used in Bellary, Mysore and the country southwards and also in Nellore and Anantápur eastwards. A few other local names have reached me attached to pens, *Pakri* is one coming from Vishnupur in the Bankura District, *Bon* is another used in Rájsháhí: *Garhan* or *Garahan* one from Muzaffarpur: *Dhour* and *Salendi* are two other

REED PEN. names used in the Bahraich District where reeds are cut and graded by the weavers who require them.

From Madras, pens of **Saccharum spontaneum** have reached me in greater numbers than those of any other **Saccharum.** The immigrant Márwáris, who are those who use such pens, seem to find it serviceable for writing in Nágari characters.

Saccharum arundinaceum. **Saccharum arundinaceum** is used for pens locally, chiefly in the Ganges Valley, the country of the Munj grass (**Saccharum arundinaceum,** *var.* **ciliare).** It is called *Sar*, *Shar* or *Shari*, and also, like **Saccharum spontaneum,** *Kanda*. At Gayá the word *Sar* is changed into *Sarka* or *Sirki*. It is also used a little in the peninsula of India as I have received specimens from Parlakimedi in the Ganjám District, Biláspur, Drúg and Malabar. The Parlakimedi specimens are labelled *Jayakana*, the Biláspur specimens *Kandsar* and the Malabar specimens *Chengamai*. I have received it under the name of *Kana* from Amritsar and Múltán.

Saccharum arundinaceum is apparently used in Cuddapah for pens. I have received thence a bundle of stems, the thickest ·8 in. (2 cms.) thick, under the name of *Veri cheruku*.

The stem of this grass is very pale in colour: it is solid and the central tissue soft and rather absorbent. It cannot be said to make good pens.

Sorghum halepense. **Sorghum halepense** is almost the chief source of country pens on the western part of the plateau of the peninsula of India. It gives solid pens very similar to those given by **Saccharum arundinaceum,** *var.* **ciliare.** As a rule they are darker in colour and slightly heavier. As far as I know they are never sold in long lengths.

The grass is very well known as *Baru* or *Bharu*, and sometimes distinguished as white *Baru* or *Tandeh baru* or in Western Bengal as *Bharuhi*. From Dumká it has reached me under the wrong name of *Kharai*. Arrah, Gayá, Dumká, Ránchi and Palámau are the most eastern places from which this pen has come to me.

To get good pens it is necessary to grow them purposely. The grass begins to grow vigorously in June and flowers in October. Just before it would flower the stems must be topped and left to grow again. Four months later, when a second flowering would occur, they may be cut for pens. Pens are thus locally prepared in most parts of the Central Provinces; but there is a very little trade in them. They are the pens there chiefly worshipped at the feast of Sri Panchámi.

REED PEN.

Sorghum vulgare, the great millet, is occasionally put under contribution for furnishing pens. Pens from it have been received from the Central Provinces, Bombay and Madras only. A man only cuts a pen from this plant when the more regular pen-furnishing grasses are not to hand. Sorghum vulgare.

Pennisetum typhoideum, the Bulrush millet or Bajra, makes very inferior pens and is only rarely used. I have received it from Patná and Bahramghát in the United Provinces. Like **Sorghum** it is but used when other pen-furnishing grasses are not to hand. Pennisetum typhoideum.

Phragmites communis and **P. Karka** furnish very brittle light hollow pens which are pale straw coloured or greenish. The second is the more important source. Phragmites communis and P. Karka.

Often the pens from this reed are of considerable diameter: I have them up to ·8 in. (20 mms.) across: but it is evident that they are preferred of smaller more ordinary dimensions.

They are very largely used in the Madras Presidency where the reed is called *Kakive daru* or *Vel Kantattai* or *Koraka Kantattai* or at Anantápur *Burrakaddi*. I have further received a few specimens from Manipur and Cachar from Western Bengal, from Múltán in the Punjáb, from Bombay, from Hinganghát in the Central Provinces, and one from Lower Bengal and one from Burma.

The reed is known as *Nal* or *Narri* in Northern India: it came to me as *Endow* from Manipur, and as *Narkal* from Muzaffarpur.

One of my pens from this reed has been cut from a particularly large specimen and is only a splint from one side.

Reeds which I found to be used at Khátmándu for pens I believe to be derived from **Phragmites communis.** They were sold under the name of Sar.

Arundo Donax furnishes a pen very like that from **Phragmites,** but is used much less frequently. The pen is a little stronger than that of **Phragmites.** I have received specimens from Nowgong in Assam, Yeotmál in the Central Provinces and Madras and Gudur in Southern India. The reed bears the same name in Madras as the last. In Nowgong it is called *Ekra*. Arundo Donax.

Triraphis madagascariensis (Neyraudia madagascariensis) is believed to be the source of a pen received from Dacca. It is a thin hard pen and is named *Kassi* and *Kasha*.

Hard fern petioles make very fair pens and have probably long been used in North-Eastern India for the purpose, first from indigenous supplies and later by import. They are used in the West of India in the finest writing "Khush Khatt" because they keep such a good point. Fern pens.

REED PEN.

The numbers of fern petioles imported into Calcutta must be considerable; they come from Penang and Singapur; and possibly a large part of them reach Singapur from Java. They are the bright brown very hard stem-like leaf-stalks with a loose core and flattened on one side which one sees so plentifully in every bazaar of Bengal. The flattened side is the upper side of the fern leaf-stalk, and the loose core the vascular bundles which in drying and with the help of decomposition have become freed from the hard outer strengthening tissue. The fern which supplies the imported pens is **Gleichenia linearis.** To Mr. J. B. Carruthers of the Department of Agriculture, Federated Malay States, I owe the specimens whereby I have identified it.

Gleichenia linearis.

The collections of pens that I have made and that have been made for me in the course of this enquiry include more examples of pen from **Gleichenia** than from any other plant. Up and down Lower Bengal and in Orissa the name *Kalmi Kalam* or simply *Kalmi* is commonly applied to it: in Upper Bengal about Patná, Gayá, Arrah, etc., it is called *Latar* and this word north of the Ganges in Tirhút becomes *Lati* or sometimes *Kalam Lati.* In Eastern Bengal it is *Lata* or *Lat* or *Latakati.* In Assam the local vernacular of the fern, which grows there freely enough, is applied to the pen and we have the name *Dhekia* or *Dheki;* but from Goálpárá and Mymensingh the name *Palang* or *Palai* comes. In Chutiá Nágpur apparently various names are applied to the pen: *Dalchini* is used at Hazáribágh; *Darchini Katal* at Ránchi, *Santhi* among the Santáls at Dumká and in Singbhúm it is reported to be variously called *Somti, Umesti* and *Killich.* The second of these three names, which is connected with Wasti, and the third do not really belong to the fern; but belong to the Persian reed-pen from **Saccharum fuscum.** Through the Central Provinces the fern is called *Bed Muska* or *Mushk beda.*

In Madras it is called *Koruka thattai* in Tamil, or at times *Java Kacan.*

This imported fern pen gets a good deal broken up on the voyage, so that from Delhi it is reported that 25 per cent. of the pieces received are useless. However it obviously pays to import it, the indigenous fern pens which might compete with it being so inferior.

Gleichenia linearis is a very widespread tropical fern which ascends the mountains of Southern India to 6,000 feet and the Himálaya to 5,000 feet. *Dhenki* or *Dhekia* as already stated is its Assamese name, and has largely passed in common parlance

to the imported pen; *Palai* is its Nágá name, *Kameng* its Manipuri name. It is probably the fern called *Chyakun*, *i.e.*, iron fern, by the Bhutias and is called *Poomol Boisong:* by the Lepchas it is called *Hari onea*, *i.e.*, black fern. Pens are made of it in the Darjeeling District. REED PEN

In many parts of Assam school boys make for themselves pens of the wild *Dhekia*, and so also is done in Manipur, but to the best of my knowledge the fern does not grow there large enough to be fully serviceable;—hence the way in which imported stems hold the market against them in the Bengal plains. The Bengalis do not generally know the origin of the fern-pens that they use; they fancy that they are locally produced by some unknown process from the runners of **Ipomœa aquatica,** a soft water plant commonly eaten as a vegetable under the name of Kalmi ság. The dealers in them in Calcutta are men in a very small way of business.

Nephrodium boryanum furnishes pens at Kohima in the Nágá hills and is called *Dhekia* like the last. It is a large fern. Nephrodium boryanum.

I have one small intensely hard fern-pen from Madura imported from Singapur, the source of which I cannot name.

We now come to the quills; they are chiefly peacocks' feathers—the black and the brown wing feathers, and sometimes the tail feathers. The brown wing feathers seem to be commonest, and almost the only ones used in Northern India. My samples of the black wing feathers come from Madura and of the tail feathers from Bellary. QUILLS.

White goose quills from the wing are used in Bengal and Assam alongside the brown peacock wing quills. They do not come up in quality to the best picked European goose quills, but are apparently imported. They are weaker than the peacock wing quills. Goose quills.

Now quills used in Europe should be carefully picked: they are not really good if taken from fatted killed geese, but only if taken from living geese in good condition.

Ten wing feathers are plucked from each goose and they fall into four grades:—

best, the second and third of the left wing,
second best, the first, fourth and fifth of the left wing,
good, the second and third of the right wing,
worst, the first, fourth and fifth of the right wing.

The second and third feathers are the strongest. The feathers of the right wing are not so good as the feathers of the left wing

QUILL. owing to the fact that in the hand of the writer they curve towards his face and may be inconvenient. After plucking they are heated in sand and undergo while hot a scraping to clean them. The heating if well done leaves them very elastic.

My examples of goose quills from Indian bazaars are all left wing feathers: all have been cut short just above the middle, and all have been scraped. They are all smaller than the best selected European quills and less firm.

Peacock quills. My peacock feather quills are by no means all left wing feathers and I believe that they are all cast feathers, picked up in the jungle about the moulting season which is September in Northern India, and in Southern India October to December.

A pea-fowl usually possesses in each wing 9—11 stout black feathers and 7—9 brown.

Calcutta serves as a distributing centre for Bengal, probably receiving its supply from several sources.

THE STEEL NIB. Nearly seventy years ago the modern steel pen was evolved in Britain and began to displace the quill. In 1818 an inventor named Joseph Bramah devised and patented a machine for cutting up the barrel of a feather into three or four pieces, which were then pointed as quills are pointed and fixed to a handle. A few years before this a Mr. Wise had folded a tube of steel into a similar form the slit of the pen being formed from the free edges. These nibs were the forerunners of the common nib of to-day, but when about 1840 the industry arose a very great deal of work had still to be done before flexibility was attained. However improvements were rapidly made and the industry which began in Britain has remained very largely British.

Attempts have been made in Bengal at nib-making but no perfection attained yet. Barisál produced these nibs: they were very inferior, crookedly cut, cross-pointed articles. If they are to hold any position their manufacture must be greatly improved. The steel sheets must have been imported in the first instance and no more than the cutting done in India.

THE CHINESE BRUSH. Last of all remains to be mentioned the Chinese brush. Chinamen in India use it always. They import it from China, and sell it in the Tiretta bazaar, Calcutta, and elsewhere. The best brushes are said to be made of marten hair, inferior brushes of the hair of other animals. The hairs are well packed into a handle of bamboo, or of some **Arundo** or of a similar grass: they are glued together into a cone so that a point is produced with only a very short length of hair free at the tip. Over the cone when not in use fits a thimble

made of a bit of perhaps **Phragmites Karka** or of bamboo. With these brushes the Chinese can make the finest lines. THE CHINESE BRUSH.

SUMMARY.

I started this ledger with a note on the material written on: and then proceeded to enumerate all the pens used in India ending with the Chinese brush. The hardness and smoothness of the surface of the first is correlated to the hardness of the pen or brush used. The Chinaman writes with his flexible brush with ease on the roughest of surfaces: the unyielding porcupine quill is only useful for the hard dust-board: and the iron style for the palm leaf. It seems that the Portuguese introduced the use of the bird-quill into Southern India: and they must have brought paper into the country at the same time. The Portuguese of course well knew the art of paper-making, but there is known to me no evidence showing that they introduced paper-making. It would be most interesting to know on what writing material the Portuguese kept their first records in India.

It seems probable that the Persian pen from **Saccharum fuscum** came into wide use with the Mughals and their spread of paper-making. The fern pen perhaps spread in use in India later and from the east side. Bamboo pens have probably been long used; but the importation of bamboo pens from China is of recent origin.

The customs in pens are changing rapidly. Already the Persian pen is only of importance as a religious emblem among a large part of the literate of Bengal: and in most parts of India it is rapidly going out of use. The quill has recently spread in use but may be expected to give place to the steel pen. Burma, the part of the Indian Empire most quick to change, has almost given up pens other than the steel nib. There all men are literate. If India as a whole becomes literate, these native pens as pens will disappear.

A list of all the plants used for making pens.

1. **Arundinaria Prainii,** *Gamble*, p. 117.
2. „ **racemosa,** *Munro*, p. 117.
3. „ **sp.** p. 117.
4. **Arundo Donax,** *Linn.*, p. 118, 125.
5. **Bambusa arundinacea,** *Willd.*, p. 117.
6. „ **vulgaris,** *Schrad.*, p. 117.
7. **Caryota urens,** *Linn.*, p. 117.
8. **Dendrocalamus strictus,** *Nees.*, p. 117.
9. **Gleichenia linearis,** *Bedd.*, p. 126.

10. **Nephrodium boryanum,** *Hook. et Baker,* p. 127.
Neyrandia madagascariensis, Hook. f. see *Triraphis.*
11. **Ochlandra Rheedii,** *Benth.,* p. 117.
12. „ **travancorica,** Benth., p. 117.
13. **Pennisetum typhoideum,** *Rich.,* p. 118, 125.
14. **Pragmites communis,** *Trin.,* p. 118, 125.
15. „ **Karka,** *Trin.,* p. 118, 125.
16. **Saccharum arundinaceum,** *Retz.,* p. 118, 123.
17. „ **fuscum,** *Roxb.,* p. 118, 122, 126.
18. „ **spontaneum,** *Linn.,* p. 118, 122.
19. **Sorghum halepense,** *Wall.,* p. 118, 124.
20. „ **vulgare,** *Pers.,* p. 118, 125.
21. **Triraphis madagascariensis,** *R. Br.,* p. 118, 125.

Other organic materials.

Quills of the porcupine, **Hystrix bengalensis,** *Blyth,* p. 115.
„ „ „ **leucura,** *Sykes,* p. 115.
„ the peacock, **Pavo cristatus,** *Linn.,* p. 127.
„ the goose, **Anser sp.** p. 127.

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THE

AGRICULTURAL LEDGER

1908-09—No. 7.

CROTALARIA JUNCEA.

(PAPERS ON SAN HEMP IN THE PABNA DISTRICT.)

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1. *Report on San Hemp in the Pábná District by* BABU UMA CHARAN PAL.
2. *Valuations of San Hemp from the Pábná District by* MESSRS. J. N. CHUNDER AND J. FERGUSON.
3. *Chemical examination and valuations in London of other samples of San Hemp from the same sources, communicated by* PROFESSOR WYNDHAM R. DUNSTAN.

INTRODUCTORY.

In March last, under the instructions from Mr. I. H. Burkill, Officiating Reporter on Economic Products to the Government of India, I went to the Pábná District to collect information about the state of the *san* hemp industry of the district. I visited all the important centres of the industry, and the following report gives details of the cultivation, methods of preparation of the fibre as pursued in different places and the way in which the fibre is disposed of from the district.

LOCALITY.

In the district of Pábná, *san* is chiefly grown in the Sháhzádpur and Ullápárá thánás (both in the Serájganj sub-division), the latter being the largest *san*-producing tract in the district. It is also grown to a certain extent in villages under the jurisdictions of Ráiganj (Serájganj sub-division) and Dulái (Sadar sub-division) police stations, but the quantities produced there are not of much importance.

SOIL, etc.

San can be grown in any land where jute or rice can be grown. But as water for steeping is of the greatest necessity, especially during the latter part of the cold weather, it is chiefly grown near rivers or *bíls* (swamps) which do not dry during this part of the year.

VARIETIES.

Two kinds of *san* are grown in the district: *Boran* and *Chotna*. The *Boran* variety is grown for fibre. The *Chotna* is not grown for fibre but is ploughed in or cut when green and left on the field

to serve the purpose of manuring which is the chief object for which this variety is grown. Often the cattle are turned into the field to eat the green leaves and twigs of the plant.

NECESSITY OF *SAN* CULTIVATION.

The cultivation of *san* of both varieties is considered necessary in order to enhance the fertility of the soil before jute or rice is grown. And generally when jute is to be grown *san* is the previous crop. In such cases there is always a greater outturn of jute than otherwise. With *san* as a previous crop, the outturn of jute per bigha (·33 acre) is from 7—8 maunds (576—658 lbs.), but without *san* this outturn falls down to 3—5 maunds (247—411 lbs.). From one field two crops are obtainable: *San* or any other crop, such as gram, sarson, etc., and jute or rice. *San* precedes both jute and rice. It is sown in Kartik (October-November) and harvested in Magh (January-February). Jute and rice are sown in Falgoon-Chaitra (March-April). As stated above the fertility of the soil is increased by growing *san* in a field, and jute or rice grown in such lands give a higher rate of outturn. But generally jute is preferred to be the crop after *san*, as jute is considered more profitable than rice. *San* is not, however, grown in the same field continually for more than two or three years. Because, if successively grown year after year, the outturn of the *san* crop becomes poor and the general practice to remedy this is to raise *san* for two or three years and then gram or sarson takes its place to precede jute or rice.

SAN AS GREEN-MANURE FOR JUTE AND RICE.

OUTTURN OF JUTE WITH *SAN* AS A PREVIOUS CROP.

METHOD OF CULTIVATION.

The method of growing *san* is very simple and is almost similar in various places of the district. Two or three ploughings are given in the field and the seed is sown and the field laddered. No hoeing nor weeding is necessary. The method is described in detail under Sháhzádpur.

AREA AND PRODUCTION.

The area under *san* in the Pábná District (almost entirely in the Serájganj sub-division) may be estimated at about 80,000 bighas or approximately 27,000 acres. The total annual production may be said to be about 130,000 maunds (4,758 tons); at any rate it cannot be more than 150,000 maunds (5,490 tons). This estimate of production is based on the information obtained from local dealers in the fibre as well as the cultivators, and is calculated as follows:—

	Mds.
Ullápárá	75,000
Sháhzádpur	45,000
Ráiganj and Dulái, etc. . . .	10,000
Total .	130,000

AREA AND PRODUCTION.

According to the rate of production per bigha the area producing this quantity, *viz.*, 130,000 maunds of *san* fibre, would be approximately 40,000 bighas. It is to be understood that this area is for the *Boran* variety only and if we add as much for the *Chotna* variety, the total area under the *san* crop would come to about 80,000 bighas or approximately 27,000 acres.* It may also be mentioned here that in the northern part of the district the area sown with the *Chotna* variety is comparatively larger than that sown with the *Boran* variety.

EXPORT AND LOCAL CONSUMPTION.

Almost the entire production of the district is exported. A small portion, however, is consumed locally, being used for fishing nets, gunnies, and cordage and ropes, especially for towing boats against stream, such ropes being known as *goons*. It is stated at Ullápárá that native merchants chiefly from Dacca, known as the *Gooniahs* (*i.e.*, dealers in, or manufacturers of, *goons*) come in during the season to purchase the fibre which they carry to their native place where the stuff is made into *goons* or other kinds of ropes.

Sháhzádpur.

SHAHZADPUR. CULTIVATION. Extent.

The *san*-producing tract within the Sháhzádpur tháná is bounded on the east by the river Jamuná, on the south by the river Borul where it joins the Huráságar (or Ooráságar). If a line is drawn through Sháhzádpur town to the town of Ullápárá, about 12 miles to the north, it is almost the western boundary of the *san*-producing tract in the Sháhzádpur tháná. On the north comes the Ullápárá tháná which is the largest *san*-producing tract in the whole district.

Markets.

In the Sháhzádpur tháná the chief markets for *san* fibre are Káijuri (on the Huráságar), Belkuchi, Khidirkol, Pangási, and Porabári (on the Jamuná), Betkandi, Bhaka, Sarotia (near Serájganj) and Tálgáchi. Of these Káijuri is the most important centre of *san* trade in this tháná.

Variety grown.

The variety grown in the Sháhzádpur tháná is chiefly *Boran*—the variety grown for fibre only. The *Chotna* variety which is solely grown for green-manuring is also sown in places to the east of Sháhzádpur town.

Method of growing. Sowing.

San is sown in Kartik (October-November) when the soil still holds moisture in it. Two ploughings are necessary before the

* This estimate of area is somewhat below that made by the Sub-Divisional Officer of Serájganj, as published in the Forecast of Rabi Crops in Eastern Bengal for 1908-09. The Director of Agriculture says: "The only estimate regarding which any definite report has been received is the *san* hemp. The Sub-Divisional Officer of Serájganj estimates that the area cropped this year in that sub-division is 30,000 acres, against a normal of 29,900."

SHAHZADPUR. CULTIVATION.

seed is sown. After sowing the seed a third ploughing is given. The next treatment is laddering and the operation is complete.

Seed. Quantity required per bigha Price.

For a bigha (·33 acre) of land about ½ maund (katcha weight, a seer = 60 tolas) of seed is required. The usual price of a maund of seed is from Rs. 6 to Rs. 8 (8*s.* to 10*s.* 8*d.*). But the price of the seed this year was abnormally high and was from Rs. 10 to Rs. 14 per maund. The seed is imported from Prasádpur (in Rájsháhi district), Purnea and Maldah. The seed produced locally is invariably worm-eaten before it is ripe and cannot, on this account, be utilised. This worm is known as *Chhenga* or *Senga*. The particulars about this pest are given under Ullápárá (see pp. 138—139).

Insect pest.

Labour for sowing.

If labour is hired, the total expenses till the completion of sowing come to about Rs. 2 per bigha.

Harvest.

The crop is ready for harvest during Magh-Falgoon (January-February). The time of harvest is indicated by the appearance of flowers and seeds. Then the whole plant is up-rooted or pulled up. A number of plants is tied in a bundle. The bundles are then steeped in water for about a week (from 5 to 7 days).

Steeping.

If the soil of the field was very dry or if the crop was left, for any unavoidable reason, on the field for a longer period than necessary, the bark at the butts becomes stiff. In such cases the bundles are first placed in water erect for a day or two and then the whole bundle is steeped in water.

Retting.

The process of retting the *san* fibre is similar to that of jute. One or two bundles are held by the left hand and the butt end is beaten with a piece of wood by the right hand. The fibre then becomes loose and then about 12 inches from the bottom the bundle is broken, the broken stalks pushed away. The fibre thus set free is held by the right hand, several pushings are given and the whole fibre comes out. Water is squeezed out of the bundle of fibre. The bundles of fibre are then hung up in the sun and shaken from time to time in order to make the fibre straight until the stuff is perfectly dry.

Drying.

Outturn per bigha.

The quantity of the crop produced in a bigha (·33 acre) of land is from 100 to 125 bundles. In favourable circumstances the outturn is sometimes so high as 150 bundles. The amount of fibre turned out by a bigha of land is on an average 4 maunds (329 lbs.).

Value.

If the average price of the fibre is taken at Rs. 6 per maund, the value of the outturn of a bigha comes to about Rs. 24 (32*s.*).

Cost of cultivation, of seed, of preparation of fibre, etc.

Cost of cultivation, of seed, of preparation of fibre, etc.

(1) As already stated, the cost of ploughing and sowing a bigha of land, if done by hired labour, is about Rs. 2 (2*s.* 8*d.*).

(2) The quantity of seed required per bigha is ½ maund (41 lbs.) the price of which is about Rs. 4 (5*s.* 4*d.*), taking the price per maund at Rs. 8 (10*s.* 8*d.*). SHAHZADPUR. CULTIVATION

(3) Assuming six men can harvest the crop of a bigha in a day, and the wages of a man annas 4 per diem, the expenses of harvesting a bigha (·33 acre) is about Rs. 1-8 (2*s.*).

(4) The expense of carriage to the waterside for steeping cannot be ascertained exactly. It varies according to the distance of the field from the waterside. It must be remembered that *san* is grown on fields not far off from the rivers, or *bils*, so that practically this expense of carriage to the waterside is nominal. In certain cases, however, this expense may be taken at Re. 1 (1*s.* 4*d.*) per bigha (·33 acre). Cost of cultivation, etc.

(5) The cost of extracting the fibre of the crop of a bigha of land may, on an average, be taken at Rs. 2 (2*s.* 8*d.*).

(6) *Rent of the land.*—Although this cannot strictly be called a part of the cost of cultivation still we cannot neglect it, being from Rs. 1-8 to Rs. 2 (2*s.* to 2*s.* 8*d.*) per bigha (·33 acre).

All these expenses may be summarised as follows:— Summary of cost.

	Rs.	A.	P.	
(1) Ploughing and sowing . .	2	0	0	per bigha.
(2) Seed	4	0	0	,,
(3) Harvesting	1	8	0	,,
(4) Carriage to waterside . .	1	0	0	,,
(5) Retting	2	0	0	,,
(6) Rent of the land . . .	2	0	0	,,
(7) Sundry expenses . . .	0	8	0	,,
Total cost .	13	0	0	,,

As already stated, the value of the outturn of a bigha is about Rs. 24. So that the net profit left to the cultivator is approximately Rs. 11 (14*s.* 8*d.*) per bigha (·33 acre). Net profit.

San fibre is generally sold in *hâts*, that is, weekly or bi-weekly markets. Cultivators from villages go to the nearest *hât* to sell off their stuff. *Phariahs* or petty dealers purchase the fibre and either sell again to some big dealer or export the article direct to Calcutta *viâ* Goálándo. These *Phariahs* or purchasers also go from village to village and buy the fibre from cultivators and make a TRADE. Disposal of the fibre.

SHAHZADPUR. TRADE.

higher profit in the bargain than otherwise. The greater portion of the production, it appears, is sold off in this way.

Sale at Talgachi.

In the weekly *hât* of Tálgáchi, about six miles to the north of Sháhzádpur, about 200 maunds (138 cwt. nearly) of *san* fibre are sold which are brought here for the purpose from the neighbouring villages, Mashupur, Kampur, Sarisakol, Durgádáhá, Nábábilá, Magurkolá, Silapára, Nariná, Betkandi, etc.

Commercial qualities and prices.

Three descriptions of the fibre are sold here:—

No. 1. *First quality.*—Price about Rs. 7-8 per maund (katcha weight of 60 tolas a seer). = Equivalent in pukka or standard weight of 80 tolas a seer = Rs. 10 (13*s.* 4*d.*) per maund (82·3 lbs.).

No. 2. *Medium quality.*—Price Rs. 6-8 to Rs. 7 per maund (katcha weight). = Rs. 9·4 (12*s.* 4*d.*) per maund (82·3 lbs.).

No. 3. *Inferior quality.*—Price Rs. 4-8 to Rs. 6 per maund (katcha weight). = Rs. 8 (10*s.* 8*d.*) per maund (82·3 lbs.).

Number 3 is sometimes assorted to two classes of which the worst qualities are seldom purchased for export.

Samples of these three descriptions were obtained from Tálgáchi, and their chemical examination and commercial valuations are given on pp. 141 and 142-143.

Sale at Kaijuri.

Káijuri is the biggest *san* market in the Sháhzádpur tháná. It is about seven miles to the east of Sháhzádpur and is situated on the Huráságar which dries up during the cold weather and the traffic is carried on by carts only. The goods from this place goes by cart to Sthalchar, a steamer station on the Jamuná, and thence *viâ* Goálándo to Calcutta.

Large quantities of *san* hemp are brought here for sale in the weekly market from villages lying between the Jamuná on the east and the Kakian on the west. Small quantities are also brought here in week days for sale. In the weekly *hât* some five to six hundred maunds of the fibre are sold.

Purchase by the Chittagong Company.

The most important buyer of the fibre in Káijuri is the Chittagong Company. The Company send an Agent here every year in January and make the purchase through him, till the end of April, when the *san* season is practically over. The Company have also their Agencies at Khidirkol (on the Jamuná), Sarotia (near Serájganj), Pangási and Porabári (on the Jamuná) in the Sháhzádpur tháná, and at Ullápárá and Nalka (on the Huráságar) in the Ullápárá tháná. It is stated that the total annual purchase of the Company from all their Agencies comes to about 30,000

maunds (22,044 cwt.). In Káijuri alone it is about 6,000 maunds (4,408 cwt.). SHAHZADPUR. TRADE.

San fibre sold in the Káijuri *hât* is assorted into four classes according to quality. It is stated that the *san* hemp produced in this locality is superior in quality to that produced in the Ullápárá tháná although the latter is the largest *san*-producing tract. This statement seems to be supported by the fact that the local prices for the different qualities of the fibre sold at Káijuri during the time of the visit were found in all cases higher by annas eight than those for their corresponding qualities sold at Ullápárá (see pp. 137 and 139-140). The commercial valuations of the fibre by the Baled Jute Association, Calcutta, and by the Imperial Institute, London, which are given at the end of this report also show that the stuffs from Káijuri carry higher values than those from Ullápárá. Sale at Kaijuri. Commercial qualities and prices.

The prevailing prices of the four classes of the *san* hemp sold in the Káijuri *hât* (by the end of March) are as follow:—

No. 1. *First quality.*—Price Rs. 8 per katcha maund (of 60 tolas a seer) = Rs. 11 (14*s.* 8*d.*) per pukka maund (of 80 tolas a seer), (82·3 lbs.)

No. 2. *Second quality.*—Price Rs. 7-8 per katcha maund = Rs. 10-8 (14*s.*) per pukka maund.

No. 3. *Third quality.*—Price Rs. 7 per katcha maund = Rs. 10 (13*s.* 4*d.*) per pukka maund.

No. 4. *Fourth quality.*—Price Rs. 6-8 per katcha maund = Rs. 8-8 (11*s.* 4*d.*) per pukka maund.

The prices at the beginning of the season, that is, during the latter part of January and in February, are generally lower than those given above and are as follow:—

	Prices at the beginning of the season, January-February, per maund, katcha weight.	Prices about the end of the season, March-April, per maund, katcha weight.
No. 1.	Rs. 7 0	Rs. 7 12 to Rs. 8 0
No. 2.	„ 6 8	„ 7 4 „ „ 7 8
No. 3.	„ 5 0 to Rs. 6 0	„ 6 12 „ „ 7 0
No. 4.	„ 4 8 „ „ 5 0	„ 6 8

Characteristics of the fibre according to which it is assorted in this *hât* are—

No. 1. Length of the fibre from six to seven feet, colour white, fibre thin and soft and strong at the same time.

Nos. 2 and 3 are assorted according to the degree of inferiority in length, colour, strength, etc., to No. 1.

SHAHZADPUR. TRADE.

If *san* is steeped in river water and especially when the water is quite pure the fibre is of good quality and is classed as No. 1 or No. 2.

Chemical examination and commercial valuations of these fibres obtained from the Káijuri *hât* are given on pp. 141 and 144-145.

Ullápárá.

ULLAPARA. CULTIVATION.

San hemp is grown largely in the Ullápárá tháná wherever water is available during the time of steeping, that is, in the months of Falgoon and Chaitra (February-March).

Extent.

The river Bural seems to be the western boundary of the *san*-producing tract in this tháná. The Bural is about 20 miles to the west of Ullápárá. It rises from the Ganges and has one branch from the Cholan *bil*. Other rivers traversing this tract are the Phuljhuri and the Muktahár. The Phuljhuri is the most important river which has its water running and is navigable all the year round for country boats. The best kind of *san* fibre is obtained from villages on its banks, *viz.*, Káliganj, Borál, Ullápárá, Sontola, Bunnyákandi, Dumduma, Rámkántapur, Sodái, Nalká, Ghurka, Poraghati, etc. The Muktahár is the other river which becomes stagnant during the cold weather. The *san* fibre of inferior quality is generally obtained from villages on its banks on account of the bad water of the river caused by continued steeping of *san*. The water becomes black and gives off such an offensive smell that one cannot pass by its banks without holding his nose. No fish can live in such waters. This is a source of malaria and had it not been for the annual inundation which carries off all these impurities the locality would have been very unhealthy.

Method of cultivation, etc.

Cultivation.—The method of cultivation, preparation of fibre, outturn, cost, profit, etc., are practically the same as detailed in the case of Sháhzádpur and is therefore unnecessary to repeat them here.

Variety.

The *Boran* is the variety grown for fibre. The *Chotna* variety is invariably grown here for green-manuring which is ploughed in, and in such fields jute or rice is grown to get a higher outturn, but preference is always given to jute as already stated. It also appears that the *Chotna* variety is grown to a large extent on the eastern side of the Phuljhuri.

Import of seed.

The seed is generally imported. Prasádpur in the Rájsháhi district seems to be the centre of supply of *san* seed to the Pábná district. It is also imported from Purnea and Maldah. Local seed is annually attacked by an insect called *Chhenga* or *Senga* before it ripens and cannot then be utilised. However, the crop sown

Local seed attacked by insect.

ULLAPARA. CULTIVATION.

early bears fruits which are not attacked by the insect and is used to a very great extent for sowing. But the fruits of the crop sown late are always attacked by *Chhenga* which spreads over the fields and a very small amount of the seed can with difficulty be obtained which has not been worm-eaten. There is one peculiarity of the attack of *Chhenga*. As long as the plants remain in the field the insect can feed on the soft green seed, but after harvesting the crops, the seed becomes hard and the insect can no more live on it and disappears. The insect also attacks the bark of plants and damages the fibre to some extent. The seed when stored up is no more attacked by any insect. The seed is only dried in the sun and stored away in any vessel and put in the sun from time to time. It would be a great benefit to the cultivators if a remedy for this attack could be found, as the price of the imported seed is heavy.

TRADE. Markets.

Ullápárá is the biggest *san* market in the Pábná District. The other smaller markets in this tháná are Kaliganj, Boral, Nalka, Nalcha, Ghurka and Poraghati.

Dealers.

An extensive trade in the *san* fibre is carried on in the town of Ullápárá. There are about fifty dealers in the *san* hemp (they are also dealers in jute). Four or five of them carry on the business on a large scale, *viz.*, Messrs. Subal Chand Chunder & Co., the Chittagong Company, Messrs. Hem Chundra Pal & Co., and Messrs. Brijraj Balchand & Co.

Disposal of the fibre.

Almost the entire stuff purchased by these firms and other petty dealers is sent down to Calcutta, the greater portion of which is exported to Europe, only a small portion being sold to the mills in the neighbourhood of Calcutta. The Chittagong Company make the purchase through their broker and agent and send the stuff to Chandpur where it is baled and then exported *viâ* Narayangunge to Chittagong and thence to Europe.

Quantity exported.

The town of Ullápárá, including other smaller markets in this tháná, exports about 60,000 maunds of the fibre annually, Ullápárá itself exporting about 30,000 maunds.

Agricultural distinction of two classes of *san* fibre.

Two classes of *san* fibre are always distinguished as obtained from two different stages of the plant, *viz.*, the *Phulsan* and the *Ghanti san*. The plants bearing only flower give *Phulsan* and require five or six days for steeping. The plants bearing seed give *Ghanti san* and require nine or ten days in steeping. The best kind of *san* fibre is always obtained from the first.

Commercial qualities and prices.

The *san* hemp sold in Ullápárá is divided into four classes of the first, second, third and fourth qualities according to the

ULLAPARA. TRADE. Commercial qualities and prices.

assortments made in the mills. The following are the particulars of these:—

First quality.—This is *Phulsan*, that is, the *san* fibre obtained from plants harvested when flowers only have been formed. If these plants are steeped in running river water the colour, strength, softness, etc., of the fibre is excellent. This description of the fibre is of the first quality: it is white, soft, woolly to the touch, fine and strong. The length of the fibre is an additional important quality. The price of *Phulsan* is about Rs. 7-12-0 per maund of katcha weight (60 tolas = a seer), being equal to Rs.10-8 (14*s.*) in pukka weight of 80 tolas a seer or a maund of 82·3 lbs.

Second quality is slightly inferior in appearance to the first. There is a good deal of difference in fineness between the first and the second, although there is a difference of a few annas only in price. The reason is that really first quality is rarely procurable and of what passes off as first quality here a greater portion has to be sold as second quality in Calcutta. Price is about Rs. 7-8-0 per maund of katcha weight or Rs. 10-0-0 (13*s.* 4*d.*) per maund of pukka or standard weight, *i.e.*, 82·3 lbs. a maund.

Third quality is inferior to the second in every respect. Its price is from Rs. 7 to Rs. 7-4-0 per maund of katcha weight or about Rs. 9-8-0 (12*s.* 8*d.*) per maund of pukka weight, *i.e.*, 82·3 lbs. a maund.

Fourth quality.—This is slightly inferior to the third and is sold at about Rs. 6 per maund of katcha weight or Rs. 8-0-0 (10*s.* 8*d.*) per maund of pukka weight, *i.e.*, 82·3 lbs. a maund.

As stated above the fibre of the first quality is obtained from *Phulsan* only when it has been steeped in a running river water, but when the *Phulsan* has been steeped in *bíl* or stagnant water, the fibre is inferior in quality and is of the second or of the third quality according as the degree of impurity of water caused by continued steeping. The *san* fibre of the third or of the fourth quality is obtained from the *Ghanti san*, that is, the seed-bearing *san* plant.

COMMERCIAL VALUATIONS.

Commercial Valuations of San Hemp from the Pábná District by Messrs. J. N. Chunder and J. Ferguson.

Samples of the fibre illustrating different qualities as sold in the markets of Ullápárá, Káijuri and Tálgáchi were procured and submitted to the Calcutta Baled Jute Association for experts' opinion. The following is the report on these samples which the Association was so kind as to obtain:—

To

The Secretary,

Calcutta Baled Jute Association.

Dear Sir,

Below we beg to give you approximate values of hemp such as submitted to you by the Officiating Reporter on Economic Products. These are based on prices which have ruled this season and which are about Re. 1 to Rs. 2 per maund higher than average of previous years. There is always a market for these kinds of hemp either by rope-makers, exporters, or fishermen for their nets. We may say that the samples which are returned herewith are rather too small to allow proper handling.

Tálgáchi	Register No.	30842	No. 1. Good, clean hemp, value Rs. 11 [14*s.* 8*d.*] per maund.
		30843	„ 2. Very poor, dirty, badly cleaned, value Rs. 6 [8*s.*] to Rs. 7 [9*s.* 4*d.*].
		30844	„ 3. Good, clean hemp, almost as good as No. 1, only fibre somewhat broken, value Rs. 10 [13*s.* 4*d.*] to Rs. 10-8 [14*s.*].
Ullápárá	„	30845	„ 1. Short fibre, fairly well cleaned, value Rs. 9-8 [12*s.* 8*d.*].
		30846	„ 2. Good clean hemp, value Rs. 10-8 [14*s.*].
		30847	„ 3. Clean, but lacks colour, value Rs. 7 [9*s.* 4*d.*].

COMMERCIAL VALUATIONS.

Káijuri	Register No.	30848	No. 1. Good, clean hemp, value Rs. 11 [14*s.* 8*d.*].
		30849	„ 2. Quite as good as No. 1.
		30850	„ 3. Very sticky, badly handled fibre, value Rs. 7 [9*s.* 4*d.*].
		30851	„ 4. Very dirty, weak fibre. Probably would fetch Rs. 5 [6*s.* 8*d.*] to Rs. 5-8 [7*s.* 4*d.*] according to demand which very often cannot be got for such low quality.

Calcutta, 26th April 1909.

CHEMICAL EXAMINATION AND VALUATIONS.

Chemical examination and valuations in London of other samples of San Hemp from the same sources communicated by Professor Wyndham R. Dunstan.

IMPERIAL INSTITUTE.

Results of the examination of San Hemp from India.

Imperial Institute No. 28941.—Dated 17th September 1909.

Talgachi samples: No. 1.

Sample No. I from Tálgáchi, Pábná District, Eastern Bengal and Assam. Regd. No. 30842. $1\frac{3}{4}$oz.

Description.—The fibre was straw-coloured and of fair lustre, fairly well-cleaned, but somewhat towy at the ends and containing some adherent tissue.

Strength.—Fairly good.

Length of staple.—7 feet.

Commercial value.—£25 per ton (May 1909). [Rs. 13·78 per maund.]

Remarks.—With reference to this and the nine following samples, the brokers reported that the prices quoted as the current values of the fibres might be regarded as fully £4 per ton above their normal values, owing to a shortage in the supply.

CHEMICAL EXAMINATION AND VALUATIONS.

No. II from Tálgáchi, Pábná District, Eastern Bengal and Assam. Regd. No. 30843. $11\frac{1}{4}$ oz.

Talgachi samples: No. 2.

Description.—This fibre was mostly grey in colour but greenish in parts and of poor lustre. It was not very well cleaned but contained a considerable quantity of woody and other matter.

Strength.—Fairly good.

Length of staple.—4 feet.

Commercial value.—£18 per ton (May 1909). [Rs. 9·92 per maund.]

No. 3.

No. III, from Tálgáchi, Pábná District, Eastern Bengal and Assam. Regd. No. 30844. 7 oz.

Description.—The fibre was of very pale straw-colour, and of fair lustre. It was fairly well cleaned.

Strength.—Fairly good.

Length of staple.—6 feet.

Chemical Examination, see p. 145.

Commercial value.—£25 per ton (May 1909). [Rs. 13·78 per maund.]

Remarks.—In chemical composition and behaviour this sample compared favourably with the samples of *San* Hemp previously examined at the Imperial Institute (compare table at end of report, p. 145).

Ullapara samples: No. 1.

No. I from Ullápárá, Pábná District, Eastern Bengal and Assam. Regd. No. 30845. $2\frac{1}{2}$ oz.

Description.—This was a very pale straw-coloured fibre, of fair lustre and slightly green in parts. It was fairly well cleaned, but contained some particles of adherent tissue, which were easily removed by gentle hackling.

Strength.—Good, but rather uneven.

Length of staple.—6 feet.

Commercial value.—£25 per ton (May 1909). [Rs. 13·78 per maund.]

No. 2.

No. II from Ullápárá, Pábná District, Eastern Bengal and Assam. Regd. No. 30846. $4\frac{1}{4}$ oz.

Description.—This fibre was of very pale straw-colour and of fair lustre. It was fairly well cleaned but contained some adherent tissue, which was easily removed on hackling.

Strength.—Good, but rather uneven.

Length of staple.—5 feet 9 inches.

CHEMICAL EXAMINATION AND VALUATIONS.

(*Chemical examination*, see opposite page).

Commercial value.—£24 per ton (May 1909). [Rs. 13·23 per maund.]

Remarks.—This fibre closely resembled No. III from Tálgáchi (Regd. No. 30844) in chemical composition and behaviour.

Ullapara samples: No. 3.

No. III from Ullápárá, Pábná District, Eastern Bengal and Assam. Regd. No. 30847. $2\frac{1}{2}$ oz.

Description.—This was a pale straw-coloured fibre, slightly darker than sample No. 30846. It was fairly well cleaned, but contained some adherent tissue, easily removed by hackling.

Strength.—Good, but rather uneven.

Length of staple.—6 feet 6 inches.

Commercial value.—£23 per ton (May 1909). [Rs. 12·68 per maund.]

Kaijuri samples: No. 1.

No. I from Káijuri, Pábná District, Eastern Bengal and Assam. Regd. No. 30848. $10\frac{1}{2}$ oz.

Description.—This sample consisted of very pale straw-coloured fibre of fair lustre. It was well cleaned and contained less extraneous matter than the other samples.

Strength.—Fairly good.

Length of staple.—5 feet 6 inches.

(*Chemical Examination*, see opposite page.)

Commercial value.—£27 per ton (May 1909). [Rs. 14·88 per maund.]

Remarks.—This sample closely resembled Nos. 30844 and 30846 in chemical composition and behaviour.

No. 2.

No. II from Káijuri, Pábná District, Eastern Bengal and Assam. Regd. No. 30849. Weight $8\frac{1}{4}$ oz.

Description.—This sample consisted of straw-coloured fibre, of fair lustre and fairly well cleaned, but somewhat gummy and containing some woody fragments.

Strength.—Fairly good.

Length of staple.—6 feet 6 inches.

Commercial value.—£25 per ton (May 1909). [Rs. 13·78 per maund, April 1909.]

No. 3.

No. III from Káijuri, Pábná District, Eastern Bengal and Assam. Regd. No. 30850. $11\frac{3}{4}$ oz.

Description.—This fibre was buff-coloured and of fair lustre, but was not well cleaned. It contained a large amount of woody and other extraneous matter.

CHEMICAL EXAMINATION AND VALUATIONS

Strength.—Fair.

Length of staple.—Average 5 feet 3 inches.

Commercial value.—£20 per ton (May 1909). [Rs. 11·02 per maund.]

Kaijuri samples: No. 4.

No. IV from Káijuri, Pábná District, Eastern Bengal and Assam. Regd. No. 30851. $10\frac{1}{2}$ oz.

Description.—This fibre was grey and had little lustre. It was not well cleaned, and contained a large quantity of woody matter and tow.

Strength.—Rather weak.

Length of staple.—4 feet to 5 feet.

Commercial value.—£17 per ton (May 1909). [Rs. 9·37 per maund.]

Conclusions.

Conclusions.—The commercial experts to whom the samples were submitted confirmed the conclusions, deduced from the results of the chemical examination, that these fibres were of remarkably good quality. They were also particularly satisfactory in respect of length, strength and colour. Several of them, especially Nos. 30842, 30844, 30845 and 30848, were above the average length and were very well prepared.

The fibres represented by the present samples would find a ready market.

It may be of interest to compare the results of the three chemical examinations made in the present instance with the figures obtained for specimens of Burmese and Indian *San* Hemp previously received at the Imperial Institute.

	Registered No. 30844.	Registered No. 30846.	Registered No. 30848.	Burmese San Hemp.	Calcutta San Hemp.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Moisture . . .	8·0	8·3	8·2	9·8	9·4
Ash . . .	0·3	0·3	0·3	3·1	0·6
a—Hydrolysis, loss .	7·5	6·3	6·7	9·2	10·5
b—Hydrolysis, loss .	16·0	15·7	15·7	15·8	14·0
Acid purification, loss .	1·0	1·0	1·4	3·7	1·6
Cellulose . . .	87·9	88·8	87·6	87·5	90·8

CHEMICAL EXAMINATION AND VALUATIONS.

This comparison indicates that the three samples from Eastern Bengal and Assam were of very good quality and closely resembled those received from Burma and Calcutta. The present samples, however, probably contained smaller amounts of soluble extraneous impurity than the latter, since they suffered smaller loss on *a*—hydrolysis and acid purification.

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